# AVIATION WEEK

A McGRAW-HILL PUBLICATION

December 2, 1957 75 cents

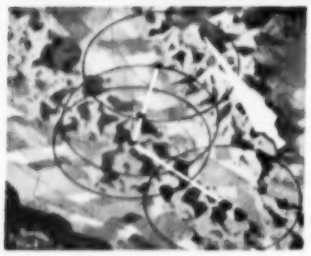

## Pilot Report: Tri-Pacer Floats Add Versatility

Fairey Rotodyne

## Design Details of Firesteak Missile

The Rheem Electronics Division is engaged in the design, development and production of ground based test and instrumentation equipment on current missile programs. *These activities include:* Electronic System checkout during production, Pre Flight system checkout (OTE), In-Flight Monitoring and range instrumentation. Rheem Electronics is also providing airborne systems, data processing systems, visual training devices and trainer simulators on current missile projects.

ELECTRONICS DIVISION
RHEEM MANUFACTURING COMPANY, *Rivera, California*



Rheem

13-57

specification:
maximum
dependability

*every fighter, every bomber, every transport is Hydro-Aire equipped.*

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HYTROL is Standard Equipment on the F-101

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When the cost of failure is too high—when maximum dependability is the most important part of the specification—the answer is HYTROL.

Super-sonic Fighters come in too fast for human reactions to get a "feel" for the braking action. Blowouts, flat spotting, and excessive tire wear are the result.

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- No more blow-outs due to skidding.
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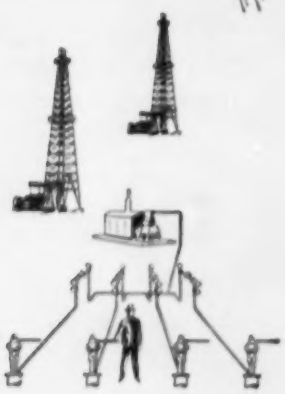

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## AVIATION CALENDAR

Dec. 1-6—Annual Meeting, American Society of Mechanical Engineers, Statler-Sheraton McAlpin Hotels, New York.

Dec. 2-6—American Rocket Society, annual meeting, Hotel Statler, New York.

Dec. 3-4—Human Factors in Systems Engineering, Institute of Radio Engineers & Human Factors Society of America, Penn-Sherwood Hotel, Philadelphia, Pa.

Dec. 4—Capabilities and Techniques of American Armament for Limited War, 39th Annual Preparedness Meeting, American Ordnance Assn., Donald A. Quarles, Deputy Secretary of Defense, honor guest, Waldorf-Astoria Hotel, N. Y. C.

Dec. 4-5—Symposium on high temperature strain gages, Aeronautical Structures Laboratory, Naval Air Material Center, Philadelphia 12, Pa.

Dec. 9-13—1957 Eastern Joint Computer Conference and Exhibit, Sheraton Park Hotel Washington, D. C.

Dec. 16-18—Air Traffic Control Symposium, "The Mission and Methods of the Airways Modernization Board," sponsored by Franklin Institute, Philadelphia, Pa.

Dec. 18—Gas Turbine Development speaker: Rear Adm. S. B. Spangler, USN, Air Development & Material Center, at Engineers Club, Philadelphia, Pa.

Jan. 6-8—Fourth National Symposium, Electronics Reliability and Quality Control, Hotel Statler, Washington, D. C.

Jan. 13-17—1958 Annual Meeting, Society of Automotive Engineers, Sheraton-Cadillac and Hotel Statler, Detroit, Mich.

Jan. 14-15—Yankee Instrument Fair & Symposium, sponsored by Instrument Society of America (Boston, Connecticut Valley and Fairfield County Sections), Hotel Bradford, Boston, Mass.

Jan. 20—Winter Meeting, Provisional Western States Section, The Combustion Institute, California Institute of Technology, Pasadena, Calif. For details write: Mr. G. S. Bahn, Marquardt Aircraft Co., Van Nuys, Calif.

*(Continued on page 6)*

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**ELECTROSET* PRESSURE SWITCH**

**Remotely adjustable without a Servo System**

Shown actual size

**SPECIFICATIONS**

**RANGE:** Adjustable 0 to 15 psia (0 to 760mm Hg)

**REPEATABILITY:** ±1mm Hg.

**ACCURACY:** ±2mm Hg.

**ACCELERATION:** 50 g in any direction

**VIBRATION:** 25 g to 2000 cps.

**WEIGHT:** 14 oz.

**TEMPERATURE RANGE:** −65° to +160°F.

**SWITCHING CURRENT:** 1 ampere resistive load

**Operates under severe environment from atmospheric pressure to vacuum with accuracy of 2mm Hg.**

The Electroset Pressure Switch offers a new and easier way to calibrate and set a pressure switch from a remote position. The contacts are automatically adjusted simply by applying the desired switching pressure and momentarily energizing a solenoid. When the solenoid is de-energized, one contact is securely clamped while the other contact remains free to move with changes in pressure. Once set, the switch will open at pressures below the calibrating pressure and close at pressures equal to or above the calibrating pressure.

The Electroset Pressure Switch is vacuum sealed, isolated from dirt, moisture or corrosive fluids, including the fluids used to actuate it. It is ideally suited for industrial process control applications where an adjustable switch must be located in a remote or inaccessible location or where the switch must operate in an atmosphere which would degrade the performance of a non-hermetically sealed unit. Among military applications are arming of warheads and control of aircraft or missiles. Write for Technical Bulletin 1570 to Trans-Sonics, Inc., Dept. 7, Burlington, Massachusetts.

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*Precision Transducers*

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Products, too, are "known by the company they keep", and CECO is proud to be airborne with many of the latest and finest military and commercial aircraft.

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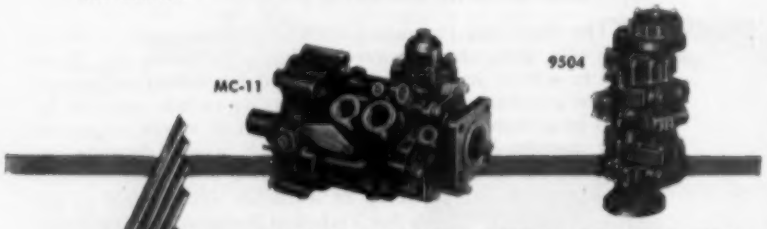


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## AVIATION CALENDAR

(*Continued from page 5*)

**Jan. 20-Feb. 7**—Aviation Institute for Commercial Carriers and Business Pilots, Univ. of Southern California, Los Angeles.

**Jan. 22-26**—International Air Show & Exposition, Master Field, Miami, Fla.

**Jan. 29-31**—Fourth Annual Meeting, American Astronautical Society, Main Auditorium, Engineering Societies Bldg., 29 W. 39 St., N. Y. C.

**Jan. 30-31**—American Society for Engineering Education, 1958 College-Industry Conference, University of Michigan, Ann Arbor, Mich.

**Jan. 30-31**—Seventh Annual Instrument Short Course, sponsored by Southern California Meter Association and Los Angeles Harbor Junior College, at Los Angeles Harbor College, Wilmington, Calif.

**Feb. 3-4**—Industry-Service Symposium, Flight Control-Panel Integration, Biltmore Hotel, Dayton, Ohio. For details: Mr. J. H. Kearns, Box 942, Dayton.

**Feb. 4-6**—Thirteenth Conference, Society of Plastics Industry, Edgewater Beach Hotel, Chicago, Ill.

**Feb. 19**—"Are Flying Saucers Fact or Fancy?", Dr. Hugh Winn, Missile and Ordnance Systems Department, GE, Engineers Club, 1317 Spruce St., Philadelphia, Pa.

**Mar. 13-14**—Second National Conference on Aviation Education, Hotel Mayflower, Washington, D. C.

**Mar. 17-20**—Joint Aviation Conference, American Rocket Society-American Society of Mechanical Engineers, Statler-Hilton Hotel, Dallas, Tex.

**Mar. 17-21**—1958 Nuclear Congress, managed by American Institute of Chemical Engineers, 25 W. 45 St., N. Y. C.

**Mar. 18-19**—First Interservice and Industry Symposium on Guided Missiles Training Equipment (limited to those with Secret clearance), Naval Ordnance Laboratory, White Oak, Silver Spring, Md. For details write: Mr. J. G. Vaeth, Head of New Weapons & Systems Division, U. S. Naval Training Device Center, Port Washington, L. I., N. Y.

**Mar. 24-29**—Fourth International Instrument Show, Caxton Hall, London.

**Mar. 30-Apr. 1**—RFC-RNAS Reunion, (World War I), Toronto, Canada. Contact: C. B. Stenning, Chairman, 149 South Drive, Toronto 5.

**Apr. 8-10**—Eighth International Symposia, Electronic Waveguides, Microwave Research Institute of Polytechnic Institute of Brooklyn, Engineering Societies Bldg., 29 W. 39 St., N. Y. C.

**Apr. 16-19**—14th Annual National Forum, American Helicopter Society, Sheraton Park Hotel, Washington, D. C.

**Apr. 17-18**—Institute of Environmental Engineers, Second Annual Technical Meeting, New Yorker Hotel, New York.

**Apr. 22-24**—1958 Electronic Components Conference, Ambassador Hotel, Los Angeles, Calif.

**Sept. 1-7**—1958 Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

**Nov. 10-14**—2nd Symposium on Physics and Medicine of the Upper Atmosphere and Space, Air Force School of Aviation Medicine, San Antonio, Tex.

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# FLOAT?

Contrary to above appearances, BRILES TITANIUM BOLTS cannot float on water. In fact, BRILES TITANIUM BOLTS are no lighter than those of any other manufacturer. HOWEVER . . .

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No photograph can tell that another man thoroughly grasps the present state of the art in infrared technology and has creative ideas for the future.

We can't show pictorially the knowledge and reasoning ability other staff members bring to such subjects as radar, general electronics, semi-conductors, computation, mechanical design, and all the other fields of competence that go to make up a balanced research and development facility.

Nor can we show the special types of gray matter that make a first class systems engineer, a top production man, or a forward-looking executive to keep these specialists functioning smoothly as an integrated organization.

But we can tell you what these people have done in the past, what they are doing now (where military security permits), and what we believe they can do for you. Write Dept AW, Mechanical Div., General Mills, 1620 Central Ave., Minneapolis 13, Minn.

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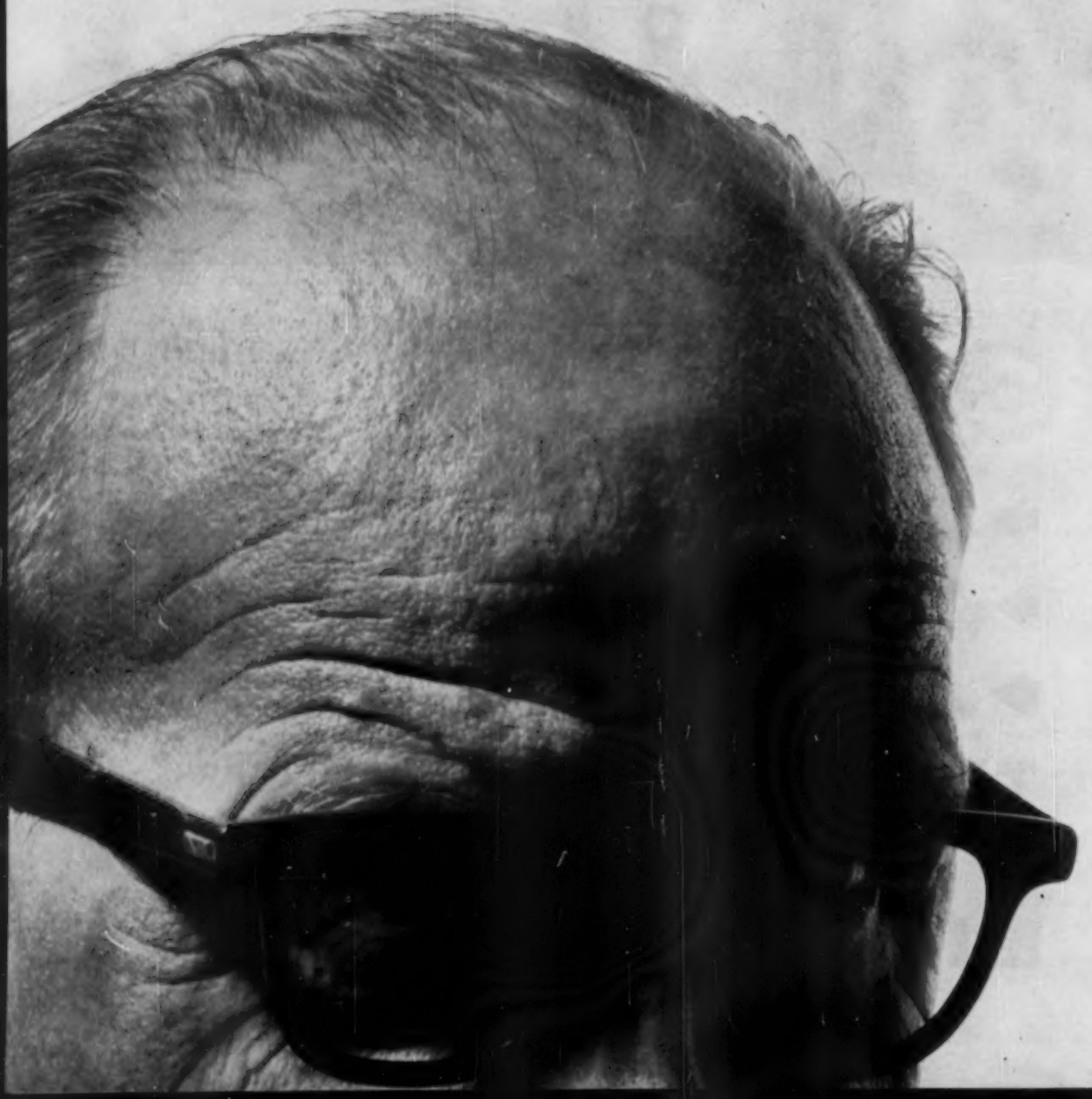


# *Now*... SEALED DEPENDABILITY IN AN EXCLUSIVE DOUBLE-POLE SWITCH

*New* ELECTRO SNAP

**HERMETICALLY-SEALED**

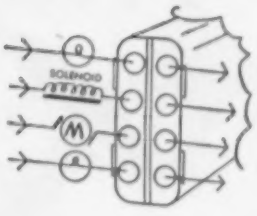
## DOUBLE-POLE SWITCH

MODEL J2-4
ACTUAL SIZE

### *Seals Out Moisture, Dirt, Oil, Corrosion, Condensation from Temperature Cycling*

With switch mechanism hermetically-sealed in a dry, inert gas, switch is dependable at any altitude, moisture or temperature condition. Use it on aircraft, machines where oil is a problem, in areas subject to freezing or extreme heat or corrosive atmospheres.

### *Controls FOUR Circuits with ONE Snap*

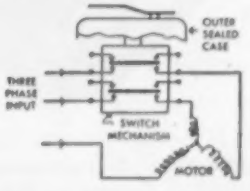



Eight separate contacts and terminals permit many unusual circuit combinations. May be wired externally for D.P.D.T., 2 circuit; D.P.S.T., normally open; D.P.S.T., normally closed. Movable poles may also be wired externally in series to increase current capacity of switch or number of contact breaks for high voltage switching.

### *Eliminates Expensive and Bulky Relays, Extra Switches*

J2-4 can control circuit combinations that were formerly possible only with complicated relays or a number of separate switches. Saves money, weight and space.

### *Starts, Stops or Reverses Three-Phase Motors*




Simultaneous action of two movable poles permits switch to break or reverse current flow through two windings of a three-phase motor. Movable poles are interlocked by unique design of switching mechanism, eliminating need of adjustment.

## SPECIFICATIONS

**Electrical Rating**—10 amps @ 125/250v AC/ 30v DC Ind.

**Operating Force**—2½ lbs.

**Weight**—2½ oz. (4 oz. with actuator)

**TOGGLE ACTUATOR**
(constant or momentary contact) can be furnished on switch. Fits AN-type toggle switch mountings.

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Attention HJR-9 • 4232 W. Lake St., Chicago 24

Please send full information on new J2-4 Hermetically-Sealed Simultaneous Double-Pole Switch.

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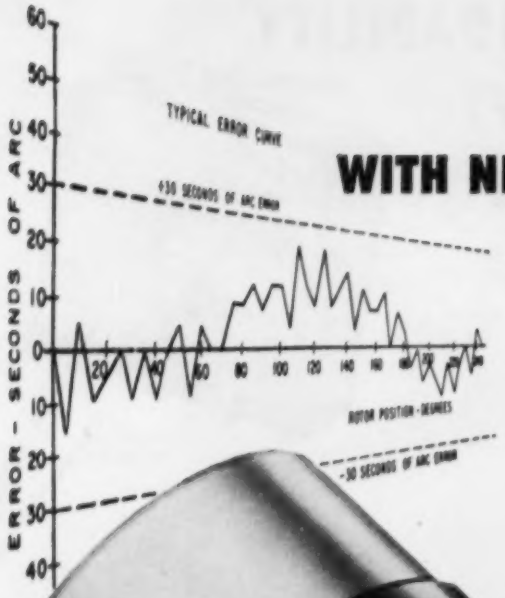
Company.....

Street.....

City.....Zone....State.....

# SYNCHROS

## WITH NEW STANDARDS OF ACCURACY

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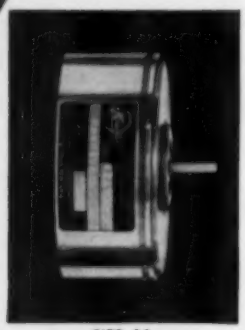
ACTUAL SIZE

SIZE 25
MAXIMUM ERROR
30 SECONDS FROM E. Z.

SIZE 11



SIZE 23

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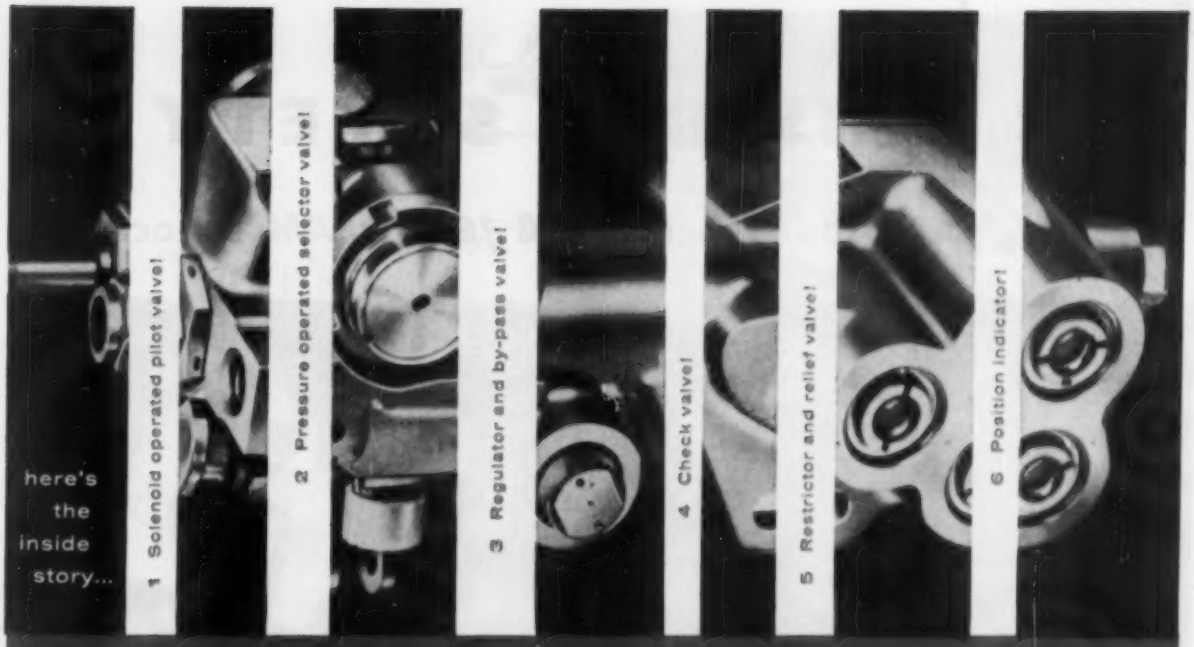


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* Jetstream is a service mark owned by TWA exclusively

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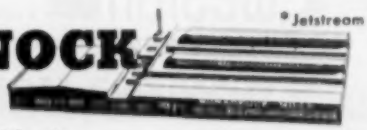

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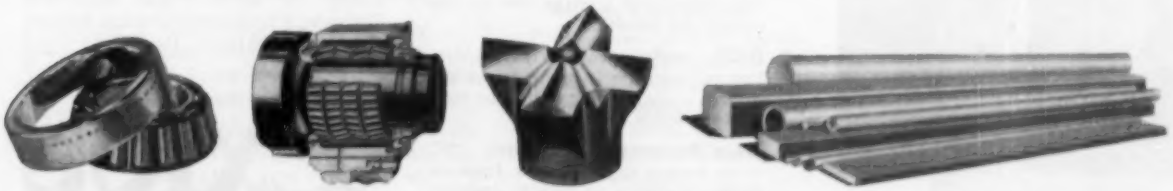
The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".



TAPERED ROLLER BEARINGS • REMOVABLE ROCK BITS • FINE ALLOY STEEL

# How long can you rely on any aircraft battery?

**SILVIUM RESISTS CORROSION**

Silvium alloy grid after corrosion test.

Non-Silvium alloy grid after some test.

**Here's the honest answer:**
You can rely on your battery only as long as it still has its rated capacity and its grid is still intact. And only the Exide Aircraft Battery has these three built-in safeguards to insure long reliability:

1. **Silvium* grids.** So resistant to long flight overcharge damage, they usually outlast the battery.
2. **GOX active material.** Ultra-fine particles pack more power per ounce . . . insure high output to meet heaviest loads.
3. **New Permax separators.** 25% more porous to electrolyte. Improve battery's ability to handle constant heavy loads.

Remember, you can't *see* a grid corroding. And when it fails, it gives no warning . . . might easily cause an embarrassing takeoff delay. Be safe. Install Exide batteries.

They cost no more than batteries that don't give you their protection. Call your nearby Exide office. Or write Exide Industrial Division, The Electric Storage Battery Company, Phila. 2, Pa.

*U. S. Patent*

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# SIOUX

## on the war path..

The Army Sioux (the Bell H-13) has tasted battle more than once. In Korea it evacuated more than 18,000 United Nations troops under enemy fire. In Algeria, today, it is repeating its warrior role for the French Army. It is serving our own armed forces here and abroad.

We hope American military men are never again called to fight. But if they are you can be sure that the Sioux will go on the war path; for battle demands proven ability . . the kind of ability engineered and built into the H-13 . . the kind of ability that has resulted in more than 2,500,000 hours of flight experience.

When there is a job for the helicopter to do, in peace or war, the Bell will do it best. That was true yesterday. It is true today. It will be true tomorrow.

*Watch* **"WHIRLYBIRDS"** *on TV . . consult your local paper for time and station*

### BELL H-13H FEATURES:

1. Longest approved overhaul period.
2. Interchangeable metal blades.
3. Cyclic boost (power steering) that incorporates latest Bell designed and developed lock and load valves.
4. Synchronized elevator that permits greatest range of cockpit loading without battery or ballast shift.

**DERATED ENGINE PROVIDES**

1. Improved hot weather and altitude performance.
2. Maximum operating period between overhauls.
3. Reduced maintenance and greater reliability.
4. Reserve power for emergencies.
5. Maximum availability — Minimum cost.

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# BOAC TURNS TO LINK FOR ITS 707 JET SIMULATOR

Link equipment has been selected to train the flight crews of another great jet fleet—the huge 707 jetliners serving the world-girdling routes of British Overseas Airways Corp.

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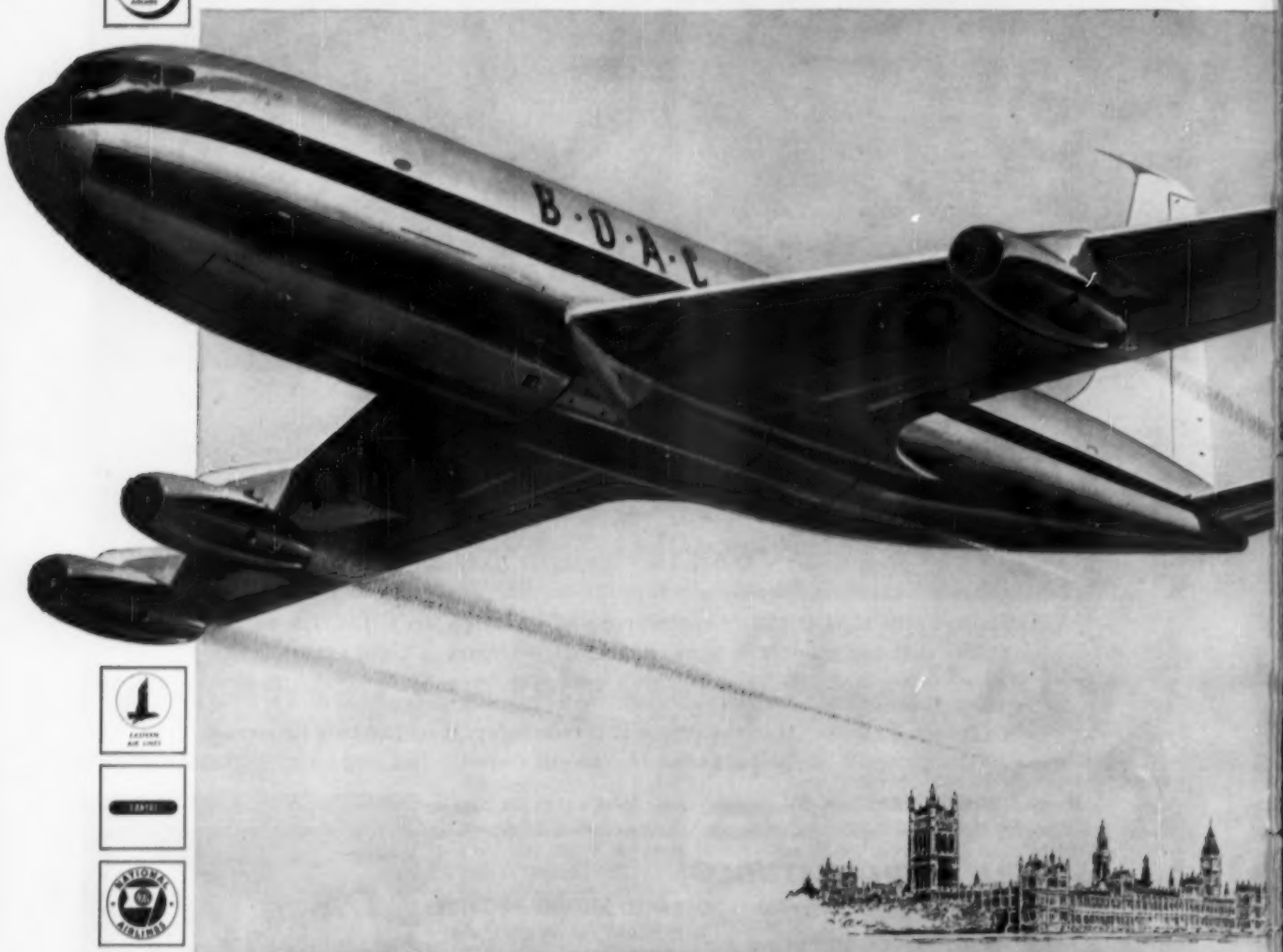


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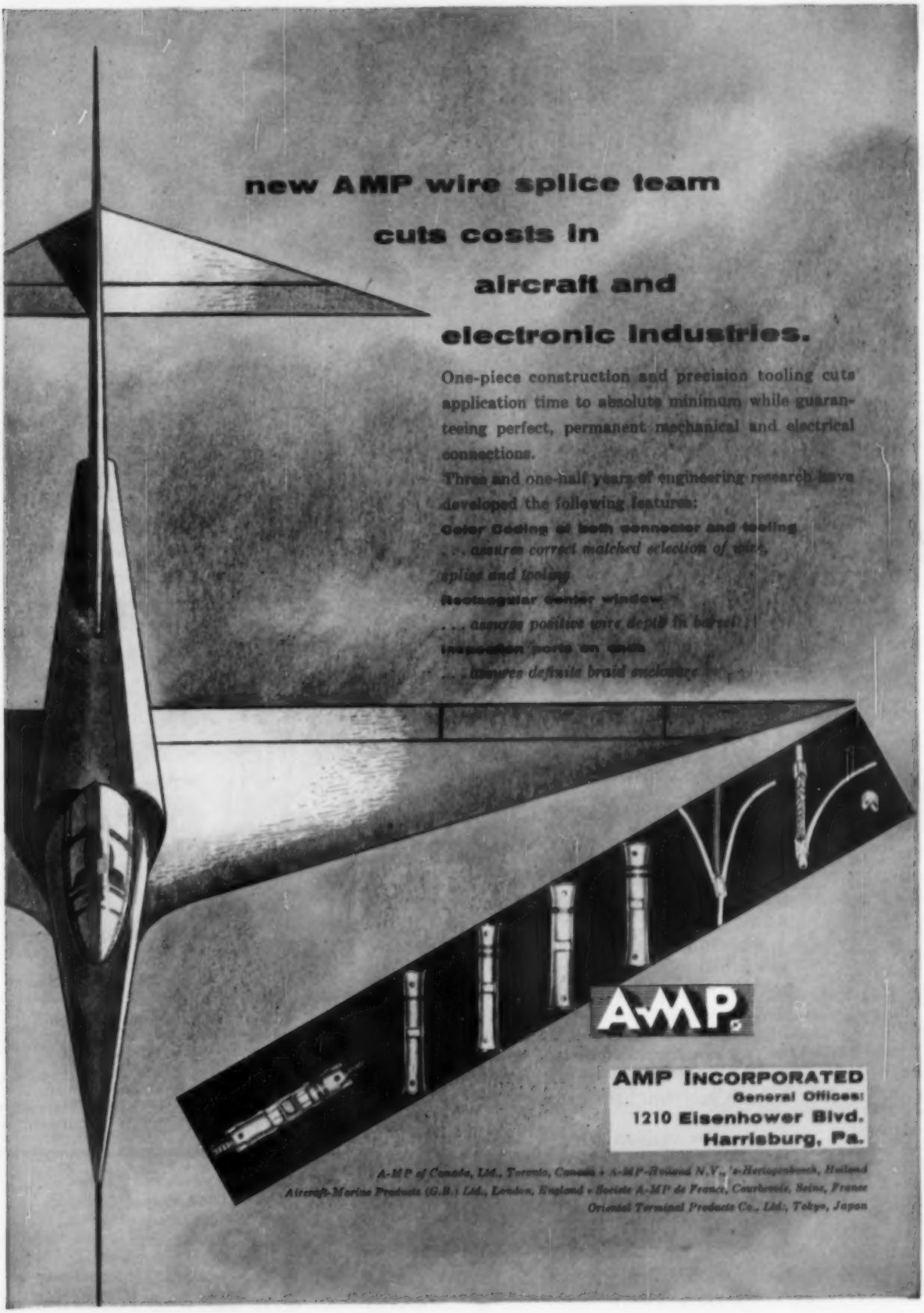
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December 2, 1957

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**COVER:** Fairey Rotodyne, now in early flight test stage, combines the takeoff and landing performance of a helicopter with the cruise economy of a fixed-wing airplane. In its present configuration, the twin-engined aircraft can carry a 10,000-lb. payload or 40 passengers. The four-bladed, 90-ft.-diameter rotor is driven by air pumped from auxiliary compressors by the twin Napier Eland turboprops. The Rotodyne is expected to cruise at 170 mph., have a range of 430 mi. and a vertical rate of climb of 1,670 fpm. (see story and other photos, p. 54).

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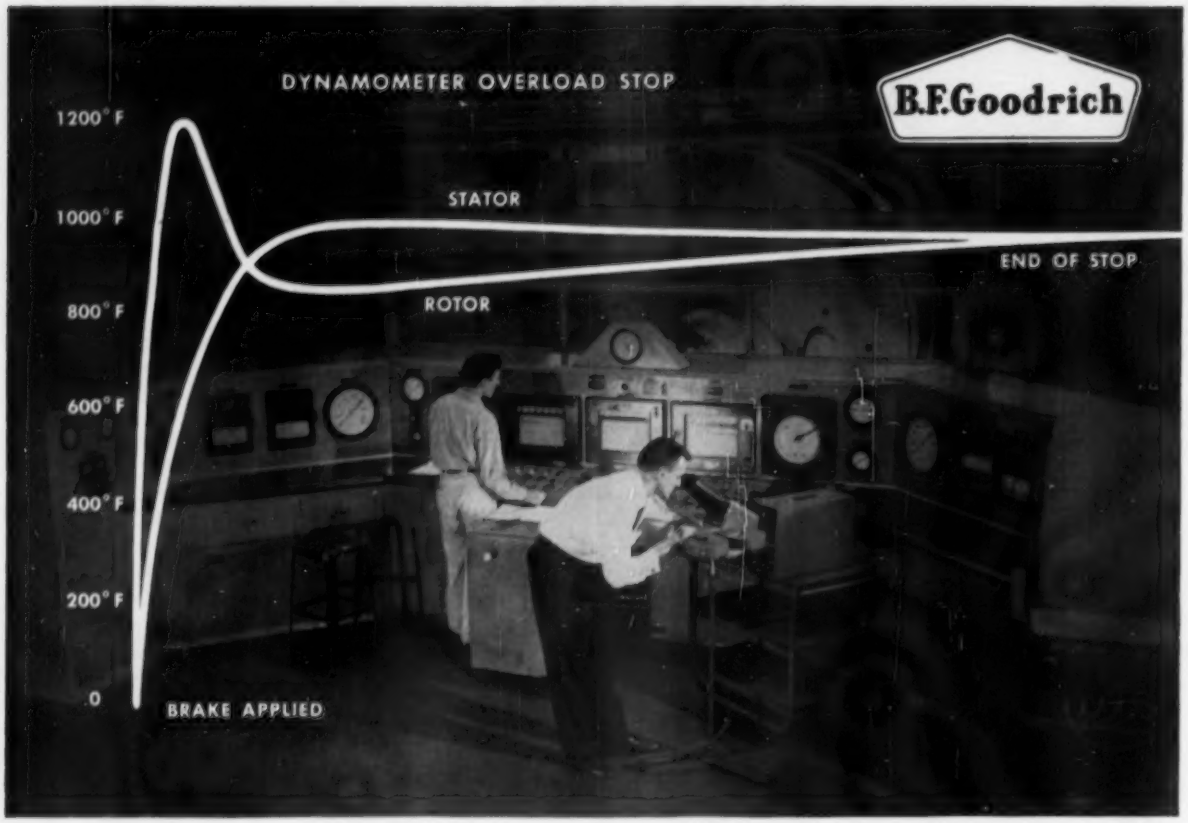


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Thermal Balance—a function of proper design—is equalized heat distribution throughout the metal parts of the brake in proportion to their respective capacities. This concept is the result of BFG pioneering the use of electrical analog computers in brake detail design.

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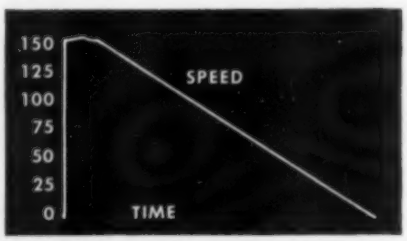


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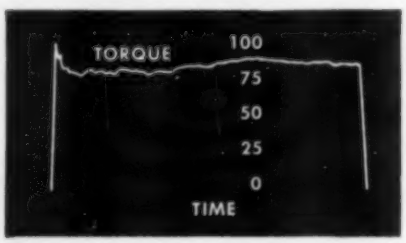


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# EDITORIAL

## What We Really Need

In the three month period since the Soviet Union announced it had successfully flight tested an intercontinental ballistic missile there has been an enormous amount of talk in this country on what we should do to retain or re-establish our overall scientific and military margin of superiority. This talk has been punctuated by the launching of the 184 lb. Soviet Sputnik I on Oct. 4—the first successful placing of an artificial satellite in an orbit around the earth—and the launching of the 1,200 lb. Sputnik II early in November carrying a dog. By the time this editorial reaches our readers, the Soviets may have Sputnik III in the sky carrying monkeys or an anthropoid ape.

We now have several committees of Congress investigating our scientific and military program, and it is a rare legislator who has not come up with some sweeping proposal to solve our military and scientific problems. A missile "czar," a Secretary of Science in the Cabinet, single managers of new weapon development, federal subsidy for science students and a single military service are among the panaceas being peddled on Capitol Hill and throughout the provinces.

### Wilson Heritage

But with all of these strong winds blowing throughout the land, there has been precious little action. The positive action taken by Defense Secretary McElroy (AW Nov. 18, p. 21) has simply restored the status quo that existed before Mr. Charles E. Wilson took his final slice at the research, development and weapons procurement budgets last summer. Mr. McElroy certainly cannot be expected to untangle the Pentagon "can of worms" he inherited in the few weeks he has been on the job.

Combing through the Washington scene and particularly the Pentagon, we are unable to find a single concrete example that indicates business is not being done as usual without any real change from the deadly complacent attitude that enveloped the executive branch of the government before the Soviets so dramatically demonstrated their long range missile capability.

Mr. McElroy's announced decision last week of putting both the experimentally built Army Jupiter and the production engineered USAF Thor IRBM into production is simply a continuation of this wasteful duplication that will siphon off funds vitally needed for more advanced projects. There has been no implementation of the many daring and technically sound space programs that have been gathering dust on Air Force and aviation manufacturers shelves for the past three years. There has been no real loosening of the purse strings in the vital basic research area where the monetary costs are low but the potential rewards in technical progress enormous. There has been no real effort to alleviate the critical problems of Strategic Air Command such as lack of new and younger trained crews, dispersed bases and facilities to maintain a constant alert.

### Action, Not Blame

But there has been a vigorous effort to pin political blame for the current situation on both the Republicans and Democrats. This is a fruitless occupation because the blame must be shared equally. The consequences of a failure to act immediately and vigorously now will be shared equally by all citizens of this land regardless of their political convictions or indifference.

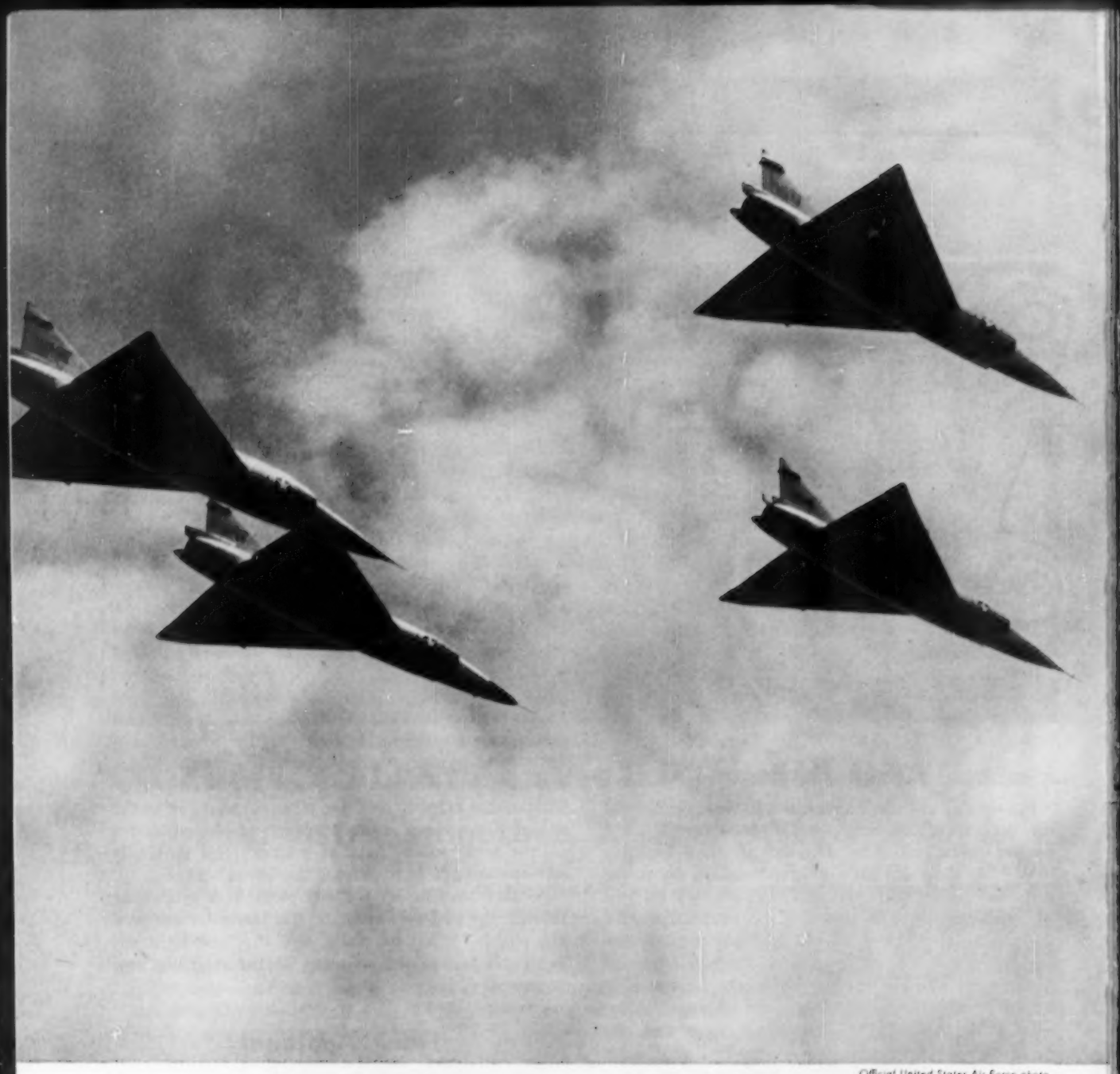
It is an historic fact that the Democratic administration when Harry S. Truman was President cut the heart out of the ballistic missile development program as well as the expansion of the Air Force and naval airpower; began the ridiculous internal security program that alienated scientists from the defense effort and lowered our military posture so blatantly that the Soviet Union felt safe in organizing armed aggression against Korea. It is equally historic that the current Republican administration has failed to heed the recurrent warnings of the rise of Russian military technology and has pursued a narrow fiscal policy that has critically and artificially retarded our ability to surpass the Soviet's pace.

So there can be no political profit in a witch-hunt through the post-war decade to affix blame for our present plight. What we really need may not be nearly as drastic or complex as many of the remedies now suggested.

### Frank Appraisal

This country suffers from no dearth of scientific talent and industrial capacity. There is no reason why this country cannot maintain a marked superiority in the new military technologies without any serious inroads on its economic stability.

It may be that what is really needed is nothing more than a clarion call from our national leadership stating our current problems frankly and without any attempt to conceal or gloss over their gravity followed by a direct exercise of leadership by the responsible officials through streamlined channels that avoid the morass of advisory committees and stagnant pools of bureaucracy and provide the scientific and industrial talent with the encouragement and financial support they need to do their job. It may be as simple as all that. —Robert Hotz



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# WHO'S WHERE

## In the Front Office

**Jay S. Boots**, president, and **Charles A. Milton**, vice president, Boots Aircraft Nut Corp., Norwalk, Conn.

**Robert W. Tuttle** succeeds **Paul H. Brattain**, retired, as president of each of the operating companies of the Airlines Terminal Corporations of Manhattan, New York, N. Y.

**Thomas E. Moffitt**, president, Hooker Electrochemical Co., Niagara Falls, N. Y. Mr. Moffitt succeeds **Bjarne Klaussen**, retired.

A. V. Roe Canada Ltd., Toronto, Canada, has appointed the following executive vice presidents: **Walter R. McLachlan**-administration and coordination; **Fred T. Smye**-areonautical; **A. C. MacDonald**-industrial.

**Glenn G. Whitaker**, vice president, Sierra Tool & Mfg. Co., Inc., Glendale, Calif.

**Chester L. Miller**, assistant vice president-operations, Alaska Airlines, Inc.

## Honors and Elections

**Donald G. Fink**, Director of Research of the Philco Corp., has been elected president of the Institute of Radio Engineers for 1958. Mr. Fink succeeds John T. Henderson, principal research officer of the National Research Council, Ottawa, Canada.

## Changes

**Dr. Leland L. Antes**, senior scientist, Electronics Dept., Hamilton Standard, division of United Aircraft Corp., Broad Brook, Conn.

**Ralph W. Kummer**, general manager, Bay Aviation Services Co., San Francisco, Calif.

**Ralph L. Bell**, military transport systems manager, and **George R. Sanborn**, director-sales and contracts, Transport Division, Boeing Airplane Co., Seattle, Wash.

**Robert S. Kinsey**, director of engineering, Utica Division, Bendix Aviation Corp., Utica, N. Y.

**Emil L. DeGraeve** has joined the corporate staff of Litton Industries, Beverly Hills, Calif. Mr. DeGraeve will handle new development planning activities.

**Gerald M. Henriksen**, director of engineering, and **Frank P. Deluca, Jr.**, director of military contracts, Acoustica Associates, inc., Mineola, N. Y.

**Sterling B. Jones**, chief engineer, Monogram Manufacturing, division of Monogram Precision Industries, Inc., Culver City, Calif.

**Albert W. Brandmaier**, manager-European regional sales office (Zurich, Switzerland), Consolidated Electrodynamics Corp., Pasadena, Calif.

**Joseph R. Graham**, manager, Instrument Division, Daydu Electronic Products, Inc., Plainfield, N. J.

**Jeffrey Cohen**, chief development engineer, Topp Manufacturing Co., Los Angeles, Calif.

**John B. Kane**, missiles project engineer-Columbus Division, North American Aviation, Inc., Columbus, Ohio.

# INDUSTRY OBSERVER

**► Russians may launch satellite carrying an atomic clock to obtain experimental verification of Einstein's general and special theory of relativity. General theory holds that a precise clock will run more slowly at extreme altitudes than an earthbound clock because of differences in gravitational fields. Special theory holds that rates of two clocks will vary because of relative motion between the two. Predicted difference in clock rates is so small that verification was not feasible prior to development of extremely accurate atomic clocks and attainability of altitude and speed differentials now available with earth satellites.**

► Watch for large scale layoffs in engineering department of Douglas Aircraft's Santa Monica Division after the first of the year. Engineering is almost complete on the DC-6 and DC-7, and United Airlines' decision to purchase the Boeing 707-720 rather than the DC-9 killed off the last hope of having a new aircraft for Santa Monica before the end of the work on propeller-driven planes.

**► More than $470 million has been spent to date on overall test facilities for USAF's Atlas and Titan intercontinental ballistic missiles and the Thor intermediate range ballistic missile.**

► Watch for closer tieups between U. S. and German aircraft manufacturers, using German design and development talent to feed American production capabilities. Both Lockheed and North American have been discussing such arrangements with German firms; Grumman and Republic are also reportedly interested. In some cases, cooperation would be contingent upon German orders of U. S. company's product. One U. S. company's plan would start with German teams doing modification engineering, special installation or armament. Company would later feed component and complete design data through German prototype of fabrication to American production lines.

**► Cornell Aeronautical Laboratory is working on a Problems of All-Weather Carrier Operations (PACO) system for Navy's Bureau of Ships. System attacks the problem of bringing many fast, low-on-fuel aircraft back to and aboard a carrier as fast and as safely as possible under any weather conditions.**

► Navy's Bullpup air-to-surface missile employs extremely simple guidance system which homes on enemy radar signals, making it effective against a variety of land or water-based targets. Bullpup is being built by Martin's Orlando, Fla., division.

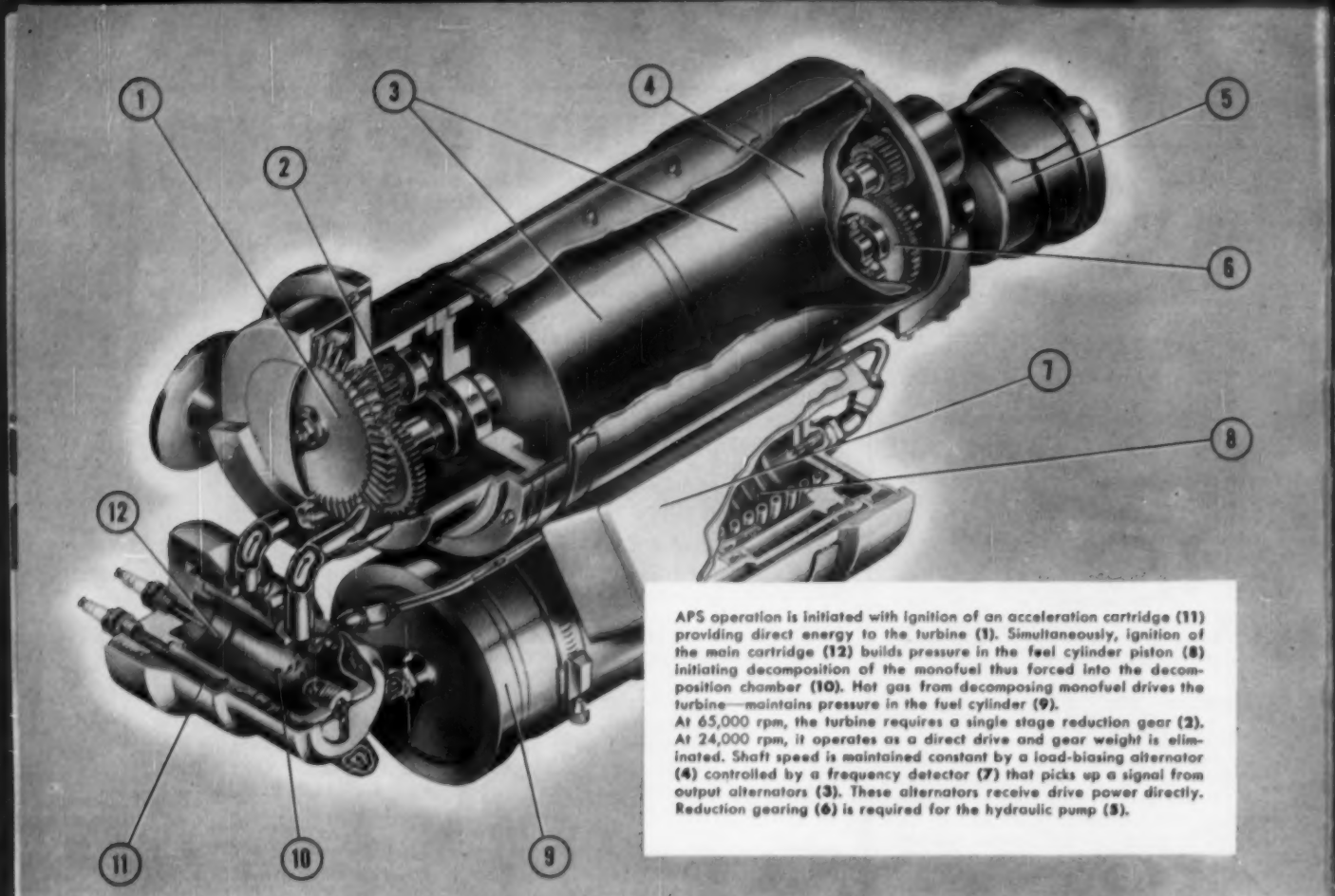
**► Boeing KC-135 jet tanker, in recent high gross weight flight tests from Edwards AFB, Calif., started taxi at 303,000 lb. gross, take off at 297,000 lb., had 400 ft. altitude and 240 kt. airspeed by the time water was exhausted on takeoff.**

► Czech-built, Russian-designed MiG-15s were offered to Swiss air force for its re-equipment program and rejected. Swiss sources said the price was good but unacceptable because the aircraft is obsolete. Rejected at the same time and for the same reason were North American F-86E Sabrejets. Swiss now hope to buy 100 Hawker Hunter F.6 aircraft for 1959 delivery as first stage in re-equipment program (AW Nov. 25, p. 27). Swiss also are interested in Chance Vought F8U-2s (AW Nov. 25, p. 23).

**► Army is instrumenting 35 Vertol H-21 helicopters for all-weather flying. Of these, 15 will be retrofitted from 1956 production, 20 instrumented on the production line. Helicopters will be assigned to Fort Rucker, Ala., for introduction into Army's helicopter instrument flight training program.**

► Gravitometer for shipboard installation is being developed for Navy by Hycon Eastern. System will be used to make gravity maps of the world.

**► Fight for German air force orders is still hot, with U. S. entries facing tough technical competition from Dassault's Mirage 3A. Sales and engineering teams feel the Germans may hold the key to a large export market and that, if they buy, the Swiss and Dutch may follow suit in short order. Japan probably would be the next major customer.**




APS operation is initiated with ignition of an acceleration cartridge (11) providing direct energy to the turbine (1). Simultaneously, ignition of the main cartridge (12) builds pressure in the fuel cylinder piston (8) initiating decomposition of the monofuel thus forced into the decomposition chamber (10). Hot gas from decomposing monofuel drives the turbine—maintains pressure in the fuel cylinder (9).
At 65,000 rpm, the turbine requires a single stage reduction gear (2). At 24,000 rpm, it operates as a direct drive and gear weight is eliminated. Shaft speed is maintained constant by a load-biasing alternator (4) controlled by a frequency detector (7) that picks up a signal from output alternators (3). These alternators receive drive power directly. Reduction gearing (6) is required for the hydraulic pump (5).

*THIS CUTAWAY SHOWS HOW*

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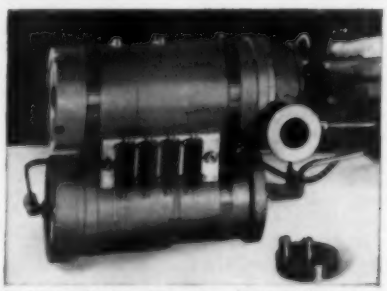
**DESIGN FLEXIBILITY,** highlighted by an easily modified fuel capacity and a compact arrangement of easily interchanged hydraulic and electric components, permits ready adaptability to a wide range of outputs and duty cycles—minimizes size, weight, and complexity of reduction gears.

For more information on how this modular system can fit your application, mail the coupon at right or contact your General Electric Aviation and Defense Industries Sales Office.

**Manufactured by General Electric's Aircraft Accessory Turbine Department, Lynn, Massachusetts.**



Thirteen inches long, ten inches high, five inches wide, thirty pounds including fuel, APS reaches rated output in one-half second.

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# Washington Roundup

## Arsenal vs. Industry

Watch for further and heated controversy over relative merits of the service arsenal and industry concepts in the field of weapon development. Back of Army's fight for the Jupiter IRBM lies its basic conviction that new tools of war must be "invented here." In opposition to the Redstone-fathered missile is the Thor built by Douglas. The aircraft company's management, engineering skill and facilities were hired by USAF to do the job. Army actually will have no tactical use for the Jupiter, knows full well that the missile will be turned over to USAF if it is produced.

Latest evidence that industry is determined to keep its role is the establishment of Space Technology Laboratories as a division of Ramo-Wooldridge Corp. Described as an outgrowth of the former Ramo-Wooldridge Guided Missile Research Division, the new unit will be headed by Dr. Simon Ramo.

Space Technology Laboratory will not manufacture, but will emphasize technical direction and systems engineering, the same service performed for USAF ballistic missile programs.

## Less Secrecy, More Progress

Among the U.S. technical experts calling for less secrecy and more progress last week (see p. 31), was former Atomic Energy Commissioner Thomas E. Murray. Murray, now a consultant for the House-Senate Atomic Energy Commission, called for a sweeping revision of the tight U.S. atomic secrecy laws to make it possible for this country to share atomic weapons and secrets with its allies. As the laws now stand, Murray said in a report to Committee Chairman Carl T. Durham (D.-N. C.), they no longer hold back Soviet atomic progress but do prevent allied countries from making a full contribution to the free world's atomic defense. Murray, however, would have the U.S. retain "exclusive custody" of hydrogen-bomb weapons.

## Decisions Still Slow

Biggest disappointment of the past two months to military men at the working level in Pentagon corridors is that there has been no evident improvement in the Defense Department's decision-making machinery.

What changes have been made in the frenzy of activity since Russia launched Sputnik I on Oct. 4 appear to add complications instead of removing them. Both military and industry representatives, bolstered by witnesses before the Senate missile inquiry, see more boxes being added to the present organization charts with great misgiving.

One hope: Dr. James R. Killian, Jr., new special assistant to the President for science and technology. With his exact role and powers still undefined, there is a possibility that he will be able to wield presidential powers and force acceleration of decision-making.

## Doolittle Disputes CIA

Central Intelligence Agency's report that Russia is finding it increasingly difficult to maintain high defense costs and still increase living standards as a spur to productivity is discounted as a factor in the Soviet vs. U. S. picture by Dr. James H. Doolittle. CIA's observation was part of its secret briefing to the Senate Preparedness Subcommittee (see page 31).

Doolittle, who mentioned the Soviet shortage of consumer goods in his own testimony earlier, said, "I do not think we can depend on this" as important. He called it "fallacious" and "wishful thinking" to give it much weight.

"The long term conflict will be determined by their willingness to get along as they are doing now as opposed to our willingness to make more sacrifices than we are doing now," Doolittle said.

CIA also told the subcommittee that by 1948, Russia had a coordinated native missile research and development program—no longer dependent on captive German scientists—and that since 1949 the program has included extensive testing of various types of short and medium range ballistic missiles.

## Research Program

House Government Operations Committee last week began an extensive investigation of the research and development programs of all government agencies. The committee, headed by Rep. William Dawson (D.-Ill.), has requested the armed services and all other government agencies to report the funds that have been requested for research and development since the end of World War II and to state whether any portion of these have been vetoed by the Bureau of the Budget. The committee also will evaluate the merits of government versus contractor research and development programs. "We want to determine whether there is wasteful duplication, excessive administrative costs, complicated procedures or organizational or financial bottlenecks" in our various research and development programs, Dawson commented.

## 'Rude Surprise'

Russia's launching of Sputnik I was "a great shock" and "a rude surprise," and "one of the finest things the Russians ever did for us," Dr. Vannevar Bush told a Senate subcommittee last week.

"It waked this country up. It hasn't been awakened like this—well, I was going to say since prohibition, but I'll say since Pearl Harbor."

## Land or Air?

On Oct. 4, the day Russia's Sputnik I first appeared, Army offered an exhibit in the spacious concourse of the Pentagon with a spotlight on these words of Lt. Gen. James M. Gavin, chief of Army research and development: "He who controls the land will control the space above it."

As Sputnik whirled away and was followed by Sputnik II with its canine passenger, USAF sarcasm became vehement.

Finally, Lt. Gen. C. S. "Bill" Irvine, cigar-chewing Deputy Chief of Staff for Materiel and veteran pilot, could stand it no longer. Said Irvine:

"Such a twist of words is a 180-degree reversal of proven fact, as any student of air/ground warfare knows. Until air—or space—supremacy is achieved, the land itself can always be made untenable."

—Washington staff

# Thor Designed for Fast Mass Production

**Components, experience gained in ICBM programs are utilized to give USAF a reliable, available IRBM.**

By Irving Stone

Los Angeles—Air Force Thor intermediate range missile was "designed down" from USAF's intercontinental ballistic missile projects to get reliable IRBM as fast as possible.

Thor, assigned to Air Research and Development Command's Ballistic Missile Division for supervision, was designed from the start as a production type weapon system. It was assigned to Ballistic Missile Division because it appeared that a good operational IRBM could be produced faster by utilizing component developments of the ICBM instead of developing the shorter range missile from scratch, with all the attendant delays.

### ICBM Tie-In

This "designing down" approach ties in Thor closely with the Division's ICBMs, the Convair Atlas and Martin Titan, and Ramo-Wooldridge Corp. has responsibility for technical direction and systems engineering for all three. Douglas Aircraft Co. is prime contractor for Thor.

Aim is to have consistency between all three of these weapons systems. One example is that, with minor variations, the logistics plan is basic for all three systems.

Correspondingly, operational experience gathered with Thor will be cranked back into the Atlas and Titan programs.

This approach has made possible these utilizations to speed reliability and advance the weapon's operational status.

• **Propulsion system** is "half" the Atlas booster powerplant, which originally had 135,000 lb. thrust barrels (AW June 24, p. 32) but since raised to 165,000 lb. each. This puts more than a year of ICBM propulsion experience into Thor and translates current ICBM propulsion tests into additional reliability for Thor. Army's Jupiter also uses the Air Force sponsored North American Rocketdyne engine that is in Thor.

• **Nose cone** is the same as the ICBMs. Because the nose cone has been designed for the more stringent ICBM service, it undoubtedly will work for IRBM ranges. Thus, heating is roughly proportional to the square of the range and cutting the ICBM range down to that of the IRBM will mean that the nose cone will only encounter about one-quarter of the heating effects.

• **Guidance** has been taken directly from that developed for Atlas ICBM.

With these basic elements established from ICBM experience, it was only necessary to introduce the major coordinating element—Douglas as prime contractor for the Thor airframe. Douglas also has responsibility for the autopilot and control system.

Use of this "designing-down" approach instead of starting from scratch to achieve wide refinements in the initial design, probably means that Thor is, in a sense, overdesigned. This is not a serious factor, and in one way it is beneficial. Factors that might cause some concern, such as heating and acceleration, can be taken care of by a generous margin of safety, in turn giving greater reliability. Additional weight resulting is not as critical in the IRBM as it is in the ICBM, since more range is available in the IRBM than military requirements demand. Even this weight can be pared by refinements when time permits after operational units are available in quantity.

Extensive testing associated with Thor is on an advanced basis, since production articles are used, proved through a regimen involving a cycle progressing from test of units to test of subassemblies, assemblies, subsystems and finally completed associated systems in the missile itself. Thus, all parts of the propulsion system have been checked out individually. The engine has been tested as a whole, and in the airframe along with autopilot and control system.

Another advantage in the design-for-production approach is that quantities are available for extensive testing. More than 30 guidance system packages were on hand before one was flown.

Thor flight tests at Cape Canaveral to date have established that the missile design is fundamentally sound and that the design-for-production approach has been justified. Six test Thors have been fired—with first missile on stand ready for launch within 13 months from November, 1955, contract date. Four of the six missile firings have been successful and at least three of the missiles fired have achieved or exceeded design distance. One report is that missile has been fired 2,645 mi., far more than military requirements.

Testing timetable obviously cannot be released, but considering speed with which Thor has been brought along it is safe to assume that a complete missile will be fired in very near future.

In addition to aiming to produce an operational missile relatively soon, Thor's design-for-production will facilitate manufacture of large numbers of these missiles within a relatively short time after a go-ahead signal. Production is expected to be no more complicated than that for a modern fighter or even the DC-8 jet transport.

Facilities Air Force could quickly adapt would permit manufacture of hundreds of Thors per month.

The production aspect is of top importance in view of the promise of Secretary of Defense Neil McElroy that Britain and other U.S. allies will get U.S. built IRBMs in 1958 (see box at left).

### Production Base

Thor's design has been essentially proved and a production base established which could be expanded, along with highly critical training and logistic support, perhaps 10 times in as many months. Development has progressed to the point where it could be ready to go into the field for operational service with squadrons in a relatively short time, as ballistic missile development goes.

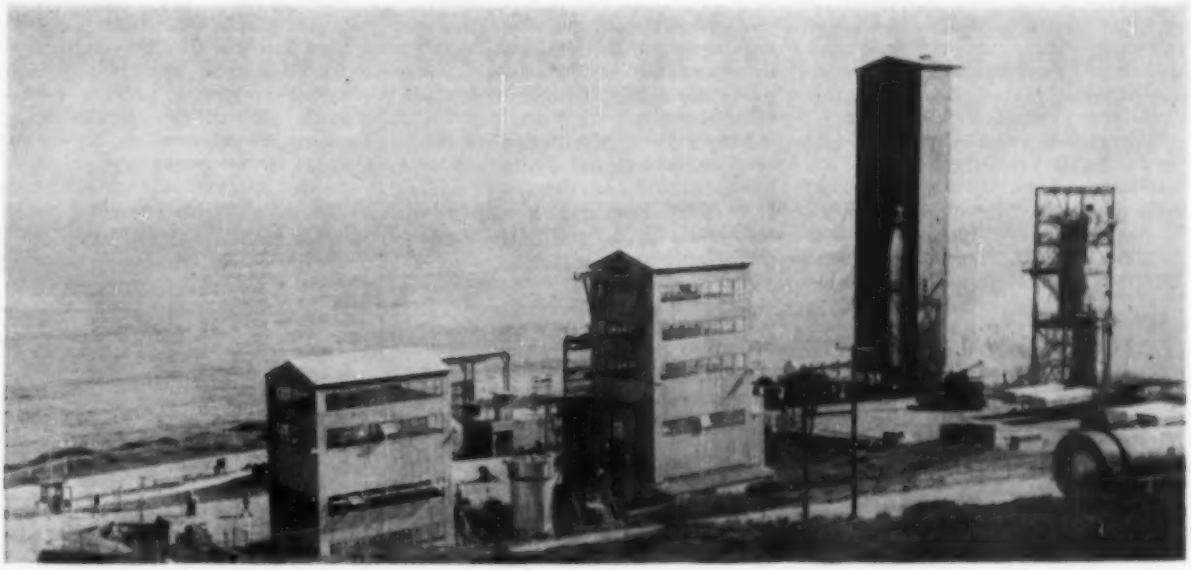
An indication of how far development of the weapon system has progressed is that final review of the system is scheduled very soon for about 50 Air Force agencies involved with operational or support aspects, to allow them to initiate detailed planning for

## Thor, Jupiter Ordered

**Washington—Both the USAF-Douglas Thor and Army's Jupiter intermediate range ballistic missiles were ordered into production last week by Defense Secretary Neil H. McElroy. McElroy said that, "by making use of the production capability now available for both the Jupiter and Thor, an operational capability can be achieved by the end of 1958 in the United Kingdom."**

**The Defense Secretary told the Senate Preparedness Subcommittee that the decision to order both missiles into production was made after an "intensive reassessment" of the U. S. IRBM program. He said that after initial deliveries are made to Great Britain, the missiles will be sent to "other appropriate locations" as "soon as necessary arrangements can be affected."**

**McElroy testified that neither missile has gone through all its test phases but that the Defense Department has been "greatly encouraged" by their success in recent tests and that they "both are at a point at which we believe we can make a sound decision to program additional production for operational purposes.**



**ATLAS** test stand site at Pt. Loma, Calif., contains a large missile model (visible in tower second from right), probably of heavy "battleship" type steel construction, which will be used by Convair for hydrostatic investigations, including effects of sloshing.

receipt of the system, although much of this planning has already been done in a preliminary manner. This participation of associated agencies at the very beginning of the project also applies to Atlas and Titan, but approach to operational status for Thor is farther advanced than in the case of the intercontinental ballistic missiles.

By comparison, Army's Jupiter is considered a "model shop" development, according to observers close to the picture. Peak production rate potential of Redstone Arsenal, Huntsville, Ala., where the Jupiters have been fabricated, is relatively low these observers say. Production type tooling is used, but units have been fabricated as prototypes since it was never intended that Redstone would be the production supplier of an operational element. With Jupiter chosen also as an operational IRBM to be put into production, Chrysler Corp. probably will be the prime contractor.

### Advance Date

AVIATION WEEK had learned before the McElroy decision from a source close to the IRBM situation that both Thor and Jupiter might be produced but that an operational target date in 1960 would be set.

This timing is considered far beyond that necessary to provide U. S. forces overseas with an effective IRBM capability if Thor alone were given the full go-ahead signal now.

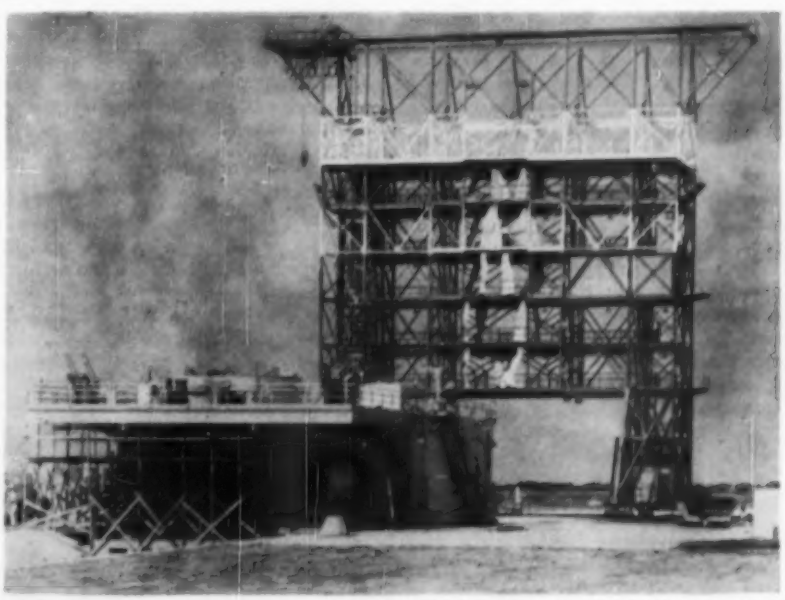
Quantity of missiles that would roll off production lines if both Thor and Jupiter were put into production would be far more than needed to fulfill the operational deployment requirements at IRBM bases.

Selection of both Thor and Jupiter will add other complications. Critical ground support equipment items which will be common to both systems will pose serious problem of availability. Allocating this equipment to both systems will spread it too thin, delay operational capability of each system.

Use of both Thor and Jupiter missile systems overseas also will seriously complicate overall logistic support problems.

While no service will reveal its timetable, estimate of experts close to the overall ballistic missile picture is that Army with its Jupiter is 12-18 months behind Thor in ability to put a mass-producible, operational IRBM weapon system into the field, considering all the ramifications of missile manufacture and creation of the extensive support elements which will have to be operated by service personnel.

Need for a large number of operational IRBMs is seen not only to counteract the immediate Russian IRBM threat but also when ICBMs become operational and are poised on pads both in U. S. and U.S.S.R. In the hands of our allies overseas a long line of IRBM launching sites would face U.S.S.R. and present a large number



**THOR** launching pad and gantry crane at Patrick AFB, Fla. Storage facilities for liquid oxygen are located in concrete bunkers near stand.

of targets and Russians would have to immobilize, making any offensive upon its part an extremely difficult task without incurring risk of crippling damage from counteroffensive IRBMs.

Tremendous effort required to weld an integrated operational weapon system such as the Thor IRBM is evident from the fact that more than 150 items of major equipment for squadron support are involved. Some of this equipment has as many as 2,000 components.

One of the prime tasks is identification of all functions, concurrent with the development of the missile. This is known as Qualitative Personnel Requirement data. It specifies what jobs must be done and what skill levels are required.

Aim is to do as many jobs as possible with skills now present in the Air Force Structure.

Equipment designs are carefully screened to reduce number of people and skill levels involved in operation. Example: when a contractor's design and a piece of checkout equipment involved use of an additional highly skilled man, this variation became immediately apparent in the light of previous analysis. Requirement for this man was eliminated and the contractor directed to remote the job to another station where the skilled operator there could take care of it.

Magnitude of the equipment development problem and determination of associated skill requirements is evident from the following key items which represent only a small part of equipment involved:

- **Fueling** facilities.
- **Liquid oxygen** devices.
- **Launching platforms.**
- **Slings and dollies.**
- **Erectors.**
- **Checkout equipment.**
- **Countdown hookups.**
- **Trainers** to determine efficiency of missile squadrons personnel.
- **Trailers.**

Extensive training base for IRBM squadrons, now under construction at Cooke Air Force Base, Calif., also will have operational capability, probably will serve as a model for international sites.

Ballistic Missile Division also is working on world-wide logistics problems to insure fast support.

# Classified Report Says Soviets Can Neutralize SAC by 1960

By Claude Witze

**Washington**—Most recent and grim evaluation of Russian military capabilities—one that puts emphasis upon the potential danger of missile-borne nuclear attack on U.S. cities—is being denied the American public by White House secrecy policies.

So far as can be learned, the report contains no information about military secrets of the Western powers but is confined to information about Russia, already known to the Kremlin.

The White House has acknowledged the report was made available to the President through the National Security Council but says comment has been denied because the data in it about Russia is "highly classified."

The report was compiled by a committee headed by H. Rowan Gaither, Jr., chairman of the board of the Ford Foundation. Other members were educators and business executives. The military was represented on an advisory board to the panel.

One of the most important conclusions of the committee is that the Strategic Air Command's bases all over the world will stand in peril of being wiped out by Soviet intercontinental ballistic missiles by 1960. This information, already known by top military and administration officials, is one of the reasons why SAC bases are recommended for top priority for anti-missile installations once a defense against an ICBM becomes plausible (AW Oct. 14, p. 37).

Another observation of the Gaither report is that the U.S. defense budget must be heavily increased to provide retaliatory airpower in the interval before we can catch the Russian missile advances. In addition to more and better aircraft, the report says SAC must carry out its dispersion program to scatter the potential targets.

### How to Meet Challenge

While the Administration refused to acknowledge the grimness of the report's outlook, at least one USAF official indicated steps that can be taken to meet the challenge.

Lt. Gen. Clarence S. Irvine, deputy chief of staff for materiel, emphasized in a speech to the National Defense Transportation Assn. that both manned aircraft and missiles must be included in USAF's inventory.

"As we see things today," the General said, "the mixed forces concept is correct because we cannot sacrifice clearly proved systems for relatively unproved ones.

"We know that manned bombers can destroy strategic targets with a high degree of accuracy and reliability. We also know that ranging interceptors can hit potential attackers at the outer fringes of our defense perimeter."

In addition, he said, there are some jobs that can be done better by manned aircraft. One of these is the task of stopping enemy bombers before they ever get off the runway.

In this connection, the General declared, point defense should be a last resort, a desperate effort to shoot down the attacker before he can drop his nuclear weapon.

### Manned Missile

Gen. Irvine said the Air Force has research under way on the subjects of manned ballistic missiles and space platforms. One reference was clearly to Lockheed's Pied Piper reconnaissance satellite program (AW Oct. 14, p. 26).

The manned ballistic missile is believed to be the hypersonic glider study being conducted by Bell Aircraft Corp. at Buffalo, N. Y. (AW March 18, p. 72). Bell's project, sometimes referred to as an "orbital bomber" or "boost glide" aircraft, is a rocket powered design.

The original Bell project name was "Bomi," later changed to "New Horizons." No announcement of a contract has been announced, but it is known that Bell and some other contractors, including Convair, are interested in the project.

In this connection, there are reports that the Russians already have tested a rocket of 820,000 lb. thrust for use in a hypersonic glide bomber, and it is believed that the Soviets have a project far in advance of U.S. efforts.

Gen. Irvine's reference to the "manned ballistic missile" and space platforms was followed by his emphasizing the need for development of long-range radars to detect ballistic missile attacks. Lack of this equipment is overlooked by some other military leaders who express optimism about the possibility of fast introduction of an anti-missile missile.

Another factor pointed out by Gen. Irvine was the USAF approach of developing production and tooling techniques along with a weapon system. For this reason, the weapon system can be ready for use as soon as it is delivered and production does not have to be delayed for the factory line to be set up and personnel trained. An example of this is the readiness of the Douglas Thor intermediate range ballistic missile for immediate production (see page 26).

On the same day Gen. Irvine was speaking, USAF announced that construction will begin next year on a $65 million missile site at Francis E. Warren AFB, Wyo.

The site will be used for training and for eventual launching of intercontinental ballistic missiles.

# Greater Role Urged for NATO Science

By J. S. Butz, Jr.

**Washington**—Western Europe's technical community will become effectively neutralized if NATO nations are not given cooperative projects for the development of large missiles and advanced weapon systems. This was the opinion of some leading U. S. and European scientists attending the Seventh General Assembly of NATO's Advisory Group for Aeronautical Research and Development here last week.

European development scientists and engineers, they say, must be given prime responsibilities concerning new weapons and their work programs brought abreast of the technological times if the free world is to obtain the maximum benefit from their talents. In short, they add, the morale of few engineers can remain high if they are restricted to working on light, subsonic fighters while space flight is becoming a reality.

The AGARD scientists told AVIATION WEEK that, if the Russians and the U. S. go into space alone, they will in every sense leave the rest of the world behind. Europe's technical community, they say, will be effectively neutralized if they are not taken into a close and mutually dependent partnership in the design of the powerplants, guidance systems, structures, etc., upon which very high speed flight depends.

Even if basic science continues to flourish and produce in Europe as it has in the past, a lack of cooperation in the development area will leave only one NATO nation, the U. S., with the experience to produce advanced hardware.

### Joint Technical Capacity

The Europeans' desire to become an integral part of high speed and eventually space flight comes at a time when the U. S. is acknowledged to be moving more slowly than the U.S.S.R. Welding the European and U. S. technical capacity into an effective and productive unity is admittedly a difficult task that the scientists admit will require the highest type of leadership from the highest level. But, they add, the rewards of such leadership would be tremendous and could increase the technical labor force available to the free world for work on first priority projects by well over 50%.

European science in a collective body would be able to contribute significantly to projects that probably would be impossible both technically and economically for the separate nations. The lift in the average citizen's morale and feeling of contributing to his own defense also would improve.

Gen. Nathan F. Twining, the keynote speaker of the two-day meeting, pointed out that the U. S. had depended on Europe until after World War II for the bulk of the basic scientific discoveries that have made aeronautical progress possible.

Then, he said, it became necessary for this government to finance large basic research programs to make up for the information which no longer came from Europe's disrupted universities and institutes. This U. S. program, and its companion development work, has been inadequate because it has not kept the U. S. advancing technically at a greater rate than the Soviet Union. Gen. Twining acknowledged that the Soviet growth rate in basic science is greater than our own and said the NATO governments must play a large part in maintaining the technical superiority of the free world.

### Word Awaited

Just what this part will be awaits word from the legislative and executive branches of the U. S. government and NATO leaders.

The U. S. Administration agrees with scientists that AGARD, conceived and directed by Dr. Theodore von Karman, has probably achieved the greatest degree of international scientific cooperation on record. Government spokesmen have said that AGARD will be used as a model for cooperative scientific groups in fields other than aeronautics, because of "its practical and productive cooperation for the benefit of the whole NATO community." After seven years of existence, the AGARD members themselves believe their existence and usefulness depends upon a much greater measure of cooperation and interdependence.

A round table technical discussion was held at the AGARD meeting on "Toward Higher Altitude."

DR. THEODORE VON KARMAN

In one of the preliminary papers delivered by Professor W. Dieminger, director of the Max Planck Institute for the Physics of the Stratosphere and the Ionosphere at Lindau, Germany, Dieminger reported that his research group believes that they have been able to pickup one of the Russian satellites at a maximum distance of 2,500 mi. for a period of two minutes with long wave length, wide band, back scatter radar equipment they normally use for studying the upper atmosphere. This equipment differs from normal radar in that it has a wave length of about 12 meters instead of a few centimeters. It is used to reflect signals off the upper atmosphere and back down to earth. As the signal strikes the earth, it scatters, and a weak portion of it returns to the radar set along the original path, bouncing off the upper atmosphere again.

This technique can be used to tell much about the reflective qualities of the various layers of the upper atmosphere and their composition.

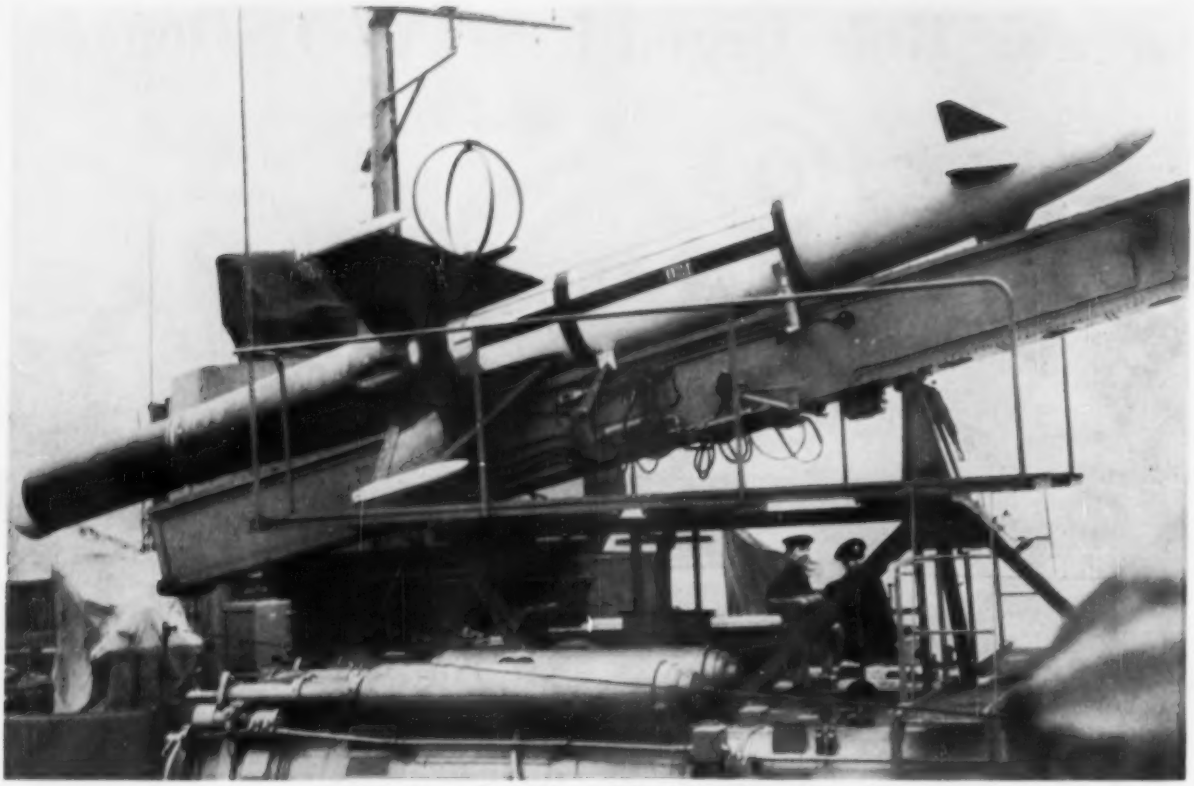
### Missile Spotting

The possibility of using such radar as a very long range spotting device for missiles is based on a property of the signal wave length. If the wave length of the signal striking a body is some multiple of the body length, then the signal resonates and its strength increases greatly so that it can be picked up by the radar receiver at great distances.

Investigations of long wave length radar with the missile spotting task in mind have just begun, and the equipment now being used probably can be improved for that mission. The only information that the radar can now give at the extreme distance is the slant range to the missile. The very wide beam width makes it impossible to get an azimuth reading. The antenna used has a rhombic shape and an area of 1,000 square meters.

Dieminger and the Max Planck Institute are proceeding with the study of this application of long wave length signals. They will issue reports of their findings in the near future.

The AGARD meeting also heard a detailed paper by Capt. Iven C. Kincheloe, Jr., who flew the Bell X-2 to a record height of approximately 126,000 ft. in September, 1956. Capt. Kincheloe's description of his flight and the training that prepared him for it was perhaps the clearest picture yet given as to the difficulties which the National Advisory Committee for Aero-



## Swedes Develop Naval Missile

**Swedish Type 315 missile, designed for use on destroyers as a surface-to-surface weapon against other vessels, is displayed aboard Swedish destroyer Smaland. A development of the experimental Type 310 missile first fired in 1946, the 315 is accelerated by four booster rockets, and cruises on an unspecified type of jet engine. The 315 airframe was first fired in 1953 and the complete missile in 1954. Test firings have taken place from a station at Karlsborg. Initially destroyers Smaland and Halland will get the weapon, also known as the Agathon.**

nautics and Air Force have encountered in their high speed, high altitude research program with manned rocket planes.

The X-2, which had the greatest performance potential of any of the manned rocket planes yet used in the program, was basically a 10-year-old design when it first flew. While it is a tribute to the Bell and NACA engineers responsible for its design that the plane traveled higher and faster than any other piloted vehicle, the X-2 had many serious problems because it was ahead of its time and much of the design data was necessarily sketchy.

Kincheloe was selected to pilot the X-2 during the high-altitude portion of its flight program after Lt. Col. Frank K. Everest had made the first seven flights in the aircraft and reached a speed of 1,950 mph.

### Training for X-2

Four altitude flights were made, building up progressively from 45,000 ft. to 126,200 ft. Kincheloe's training began before Everest's first flight and continued through to his own record altitude flight. The training program was altered on the basis of information gained from each flight of the vehicle.

The most important part of this training according to Kincheloe was a simulator used in conjunction with a GEDA analog computer. The estimated stability derivatives of the X-2 were modified on the basis of flight test experience and the pilots were able to "fly" the aircraft many times on the ground to determine the flyable, marginal and unflyable conditions.

### Flight Account

X-2's stability and instrumentation problems are described by Kincheloe in a detailed account of his flight to 126,000 ft.

Upon release from the mother aircraft, he fired the rockets and, because of limited longitudinal control, had to start his rotation to the climb angle of 45 degrees immediately. He pulled the stick full back and held it there until he had essentially flown out of the atmosphere and re-entered again.

Just before his propellants burned out at about 90,000 ft., a small asymetrical thrust developed and the aircraft banked to the left through a large angle. The simulator studies had shown that very large bank angles should be corrected cautiously at high altitudes to avoid a slow, but very difficult to control, rolling motion.

Severe roll couplings also could be expected through use of the rudder. Therefore, Kincheloe rode the X-2 through its semi-ballistic path to a point beyond 99% of the earth's atmosphere, back down into dense air and recovered at about 40,000 ft., all without moving the controls after first pulling the stick full back. He passed through the peak of his trajectory and re-entry phase in a severe wing down attitude.

The X-2 flight instruments were useless for the most part, Kincheloe said. The altimeter read consistently about 12,000 ft. low during the climb, so he was tracked by radar from the ground and his altitude radioed in 5,000 ft. increments. His attitude gyro did not function properly, so the ground crew used a grease pencil to mark a line on the glass canopy which would be horizontal when he was at the 45 degree climb angle. Even though he had little if any control over this climb angle, the line would indicate whether the climb had stabilized near the desired angle.

# Teller, Doolittle, Bush Ask More Defense

By Evert Clark

**Washington**—U. S. must strengthen its military defenses immediately, put much greater emphasis on research and science in general and make vast improvements in its educational system if it is to survive the rapidly growing threat of Russian scientific, military and political superiority, the Senate Preparedness Subcommittee was warned last week.

All this will take more money and means longer hours and harder work for the nation, witnesses said.

Outstanding men from the country's military and civilian scientific programs told the subcommittee that Russia already leads the U.S. in a number of areas of science and technology, is gaining rapidly in most others and threatens seriously to surpass this nation in all fields because her rate of progress is greater than ours.

First witnesses were Dr. Edward Teller, Dr. Vannevar Bush, Dr. James H. Doolittle, Dr. John Chipman and Dr. John P. Hagen.

Teller is associate director of the University of California Radiation Laboratory and a leader in development of thermonuclear weapons. Bush is chairman of the Board of Massachusetts Institute of Technology and wartime director of the Office of Scientific Research and Development. Doolittle is chairman of the National Advisory Committee for Aeronautics and the Air Force Scientific Advisory Board. Chipman is chairman of MIT's metallurgy department and Hagen is director of Project Vanguard.

### What's Needed

Teller, Bush and Doolittle were generally in agreement on what steps needed to be taken immediately to begin meeting the Russian threat:

• **Provide more money** wherever needed to strengthen present defenses—particularly Strategic Air Command, missiles and submarine-anti-submarine efforts—and to spur research and development. Doolittle said the "urgency of the situation" calls for an "immediate and substantial increase in our military budget." All three cautioned that money is not the sole answer, but all agreed lack of funds has done harm in the recent past, especially in basic research.

• **Improve organization of** the defense structure—but gradually, so that no present effort is slowed down in the process. "We are now in the position that we have to go on. We cannot stop and create the ideal situation," Bush said. All three called for quicker decision making and clearer lines of responsibility but they were inclined to think it could and should be done chiefly through existing offices.

Bush called for a central planning board to do what he said the Joint Chiefs of Staff have not been able to do—make unified war plans. He said the Joint Chiefs, who also command their respective services, cannot and have not made some decisions which must be made and have not been unanimous on others.

Doolittle suggested a staff of "young, aggressive" military advisers to the Secretary of Defense who would be relatively free from loyalty to a particular service and would serve approximately the same function as the board Bush suggested. Both said there might be better solutions than those they offered.

Doolittle said the country may be headed toward "a single service with one uniform," although he is not ready to advocate it now, and toward a general staff. Bush specifically opposed a single service but urged the subcommittee to "overhaul the National Unification Act, which has never worked," and eliminate "damaging" interservice rivalry. Doolittle said fear of the general staff concept was unwarranted.

• **Vastly improve scientific** and technological aspects of education, the underlying reason for Russia's great gains. This would include more classrooms, more and better science teachers, more and harder work by students and probably subsidies to both teachers and students. All three said this is the heart of the solution of the long-range problem. Bush called the situation in education now "appalling."

• **Greatly increase the prestige** of science and scientists. Teller said some Russian scientists make 50 times as much as a Russian day laborer. In the U.S., some do not make as much, he said. Bush said the U.S. has generally had "a great disrespect for scientists," and has sometimes "felt they were not to be trusted." "I hope at last we have matured," Bush said.

DR. EDWARD TELLER

In varying degrees, all three advocated less secrecy. Bush said the country has "probably as many secrets to learn as to keep secret" now and "overemphasis on that sort of thing is infantile."

Chairman Lyndon Johnson (D.-Tex.) said the subcommittee hopes to get a clear picture of the threat to U.S. security. He called it "perhaps the greatest our country has ever known." No witness has disputed him. Hearings were attended by a number of members of the parent Senate Armed Services Committee, and a large audience.

Dr. Hagen, director of U.S. satellite launching efforts, called for a single agency, possibly within the Defense Department, to direct all satellite and space ship programs. This must be done "if we intend to go anywhere in this area," and it must have full power to set policies and "the responsibility and authority for action." It should encompass "further space investigation and flight," including studies on manned satellites.

Both Teller and Doolittle urged research and development aimed at space flight. This also requires "a sound educational program," Doolittle said. Teller said he is "sure that Sputnik has made the recruiting problem (for space programs) a particularly easy one."

### Improve Education

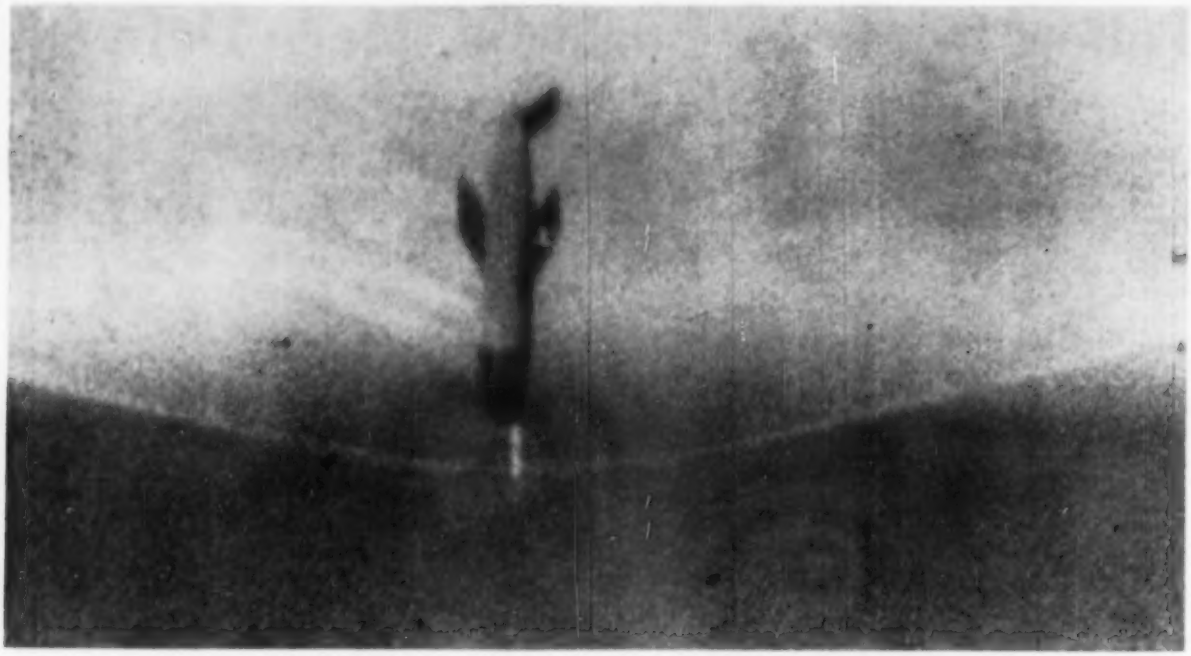
Dr. Chipman, who toured two Russian steel plants and four metallurgical institutes in Russia last summer, urged spending two or three times as much on basic research as the U.S. now spends, and strongly advised all possible steps to improve education.

Russia now graduates 4,500 metallurgists a year to 650 in the U.S., and has twice as many metallurgists working for doctorates as the U.S., he said. Of the 4,500, some 900 are women—more than the total number graduated in the U.S. Training is good, there are four or five applicants for every position, and students get a graduated stipend instead of paying tuition.

The older steel plant is used entirely for research and development and training and the newer one is "as good as any in the U.S.," Dr. Chipman said. Russia is "every inch as good" in basic steel producing techniques as this country, he said.

In addition to larger steps, the witnesses recommended:

• **Teller: Immediate strengthening of**



## Shock Wave Forms on Diving Regulus 1

**Shock wave building ahead of a Regulus 1 missile at supersonic speed in a terminal dive is caught in unusual photograph taken by the Sandia Corp. Behind detached shock wave can be seen faint light lines from fuselage marking expansion waves. Atmospheric conditions made it possible to photograph the shock waves, usually only visible in Schlieren photographs taken in wind tunnels. Shape of wave indicates the missile was traveling at Mach 1.1. Picture was taken through a 60-in. F5 reflective telescopic lens at a distance of 1.5 mi.**

SAC by adding planes and crews and dispersing bases and planes. Doolittle, replying to questions by Sen. Stuart Symington (D.-Mo.), urged increased B-52 production and called the B-36—which still outnumbers B-52s in SAC—"obsolete."

Teller also recommended more money for nuclear-powered missile submarines and greater emphasis on passive defense—possibly including a shelter program to protect against fallout and firestorms; dispersed stockpiles of food, machine tools, trucks, etc., so Russia could never completely cripple the nation, even with an all-out attack. This is an important part of the "deterrent" concept, he said. He suggested drawing more individuals and companies into missile work and said he would not kill many missile programs. Rather, he would select some for military uses and use others for research and space exploration. Asked about cutbacks in nuclear rocket and nuclear aircraft propulsion, Teller said he has been a member of Atomic Energy Commission's General Advisory Committee for about a year and, although he believes there must be re-evaluation of these two programs, "In my private opinion . . . I am in favor in general with what has been done."

• **Bush: Expressed some** skepticism of a broad shelter program, "The war of the future may not be exactly what we think it will be," he said. He urged careful study of the chemical and biological warfare threat.

• **Doolittle: All-out effort** on an anti-missile missile and the complementary missile-detecting radar is needed now. He also urged immediate work on radar detection, including extension of the sea arms of the detection network; improvement of Air Defense Command and Tactical Air Command aircraft and increased airlift for the Army. He also said we must maintain a sound economy and a high morality to withstand a cold war that may last "one, five, 10, 50 or a 100 years." Doolittle said Maj. Gen. Bernard Schriever, commander of USAF's Ballistic Missile Division, told him a week before that the intercontinental ballistic missile program had enough funds for present, but there would be "points where they come up against handicaps and he would need help then." Doolittle said progress on an intermediate range ballistic missile would be faster if all the people working on USAF's Thor and Army's Jupiter were lumped together. He said "hearsay" has it that a decision will be made by Jan. 1 as to which will become an operational weapon.

Criticizing our "butter economy," Doolittle said economists estimate that Russia puts 25% of its gross national product into arms and the U.S. puts 8.5%.

In 1947, Russia's industrial base was one-seventh of ours. Now it is about one-third, and "increasing twice as fast," he said. Russia's gross national product now is about one-third of ours "and increasing half again as fast."

Russian students finish high school in 10 years to our 12, and have 12-hour, six-day weeks, Doolittle said. All high school graduates have studied algebra, geometry, trigonometry versus 14% of U.S. students, and they also have had calculus. All have five years of physics. Here, 25% take one year of physics. All take four years of chemistry. Here, one third study one year of chemistry.

Doolittle said Soviet Russia has a "double incentive system" for all its people, which he would not advocate for the U.S.—"you are rewarded if you do well or destroyed if you don't."

## Engine Icing Fixes Tested on Britannia

**London**—Bristol Aeroplane Co. has sent a long range Britannia 312 to Singapore to try out under actual monsoon-conditions two types of modification in the icing-plagued Proteus 755 engine.

Outboard power plants are equipped with a device for tapping air from the engine compressor and reintroducing i through a number of small nozzles in the engine intake duct.

Inboard engines have the second

modification: new heating system.

Forty-two technicians were aboard the Britannia, as well as two observers from British Overseas Airways Corp. Bristol's chief test pilot, Walter Gibb, is plane captain.

If the Singapore trials and other proving flights are successful, BOAC hopes to start non-stop transatlantic passenger flights with the Britannia on Dec. 19th.

Both de-icing techniques in the Britannia at Singapore showed good results on ground rigs at Farnborough.

In the two outboard engines multiple nozzles—25 of them—are fitted to the outer wall of the intake duct. These direct jets of air along the inner surface of the rear wall of the intake in order to accelerate the boundary layer and so prevent ice accumulating on this surface.

Spaced about six inches apart, the air jet nozzles are supplied by means of a manifold encircling the intake. Air is bled to manifold from the cabin air pressure tapping taken from the final delivery stage of the engine compressor.

Amount of air tapped from the compressor is approximately one-half lb./sec. When this is in operation it causes a slight loss of power and a small increase in specific fuel consumption.

In terms of aircraft performance, this would mean a cruising altitude about 1,500 ft. lower and a 2% loss of range—if the system were in operation all the time. But normally, Bristol says, only a small proportion of any flight would be carried out under these conditions.

The two inboard engines will have increased heat applied to the walls of the air entry duct, which will now be heated by gas at 180-300C instead of the standard 180C. The hot gas is fed to the rear of the curved wall of the air intake at the bend directing the air into the engine compressor.

Bristol says it also has improved distribution of the hot gas.

## News Digest

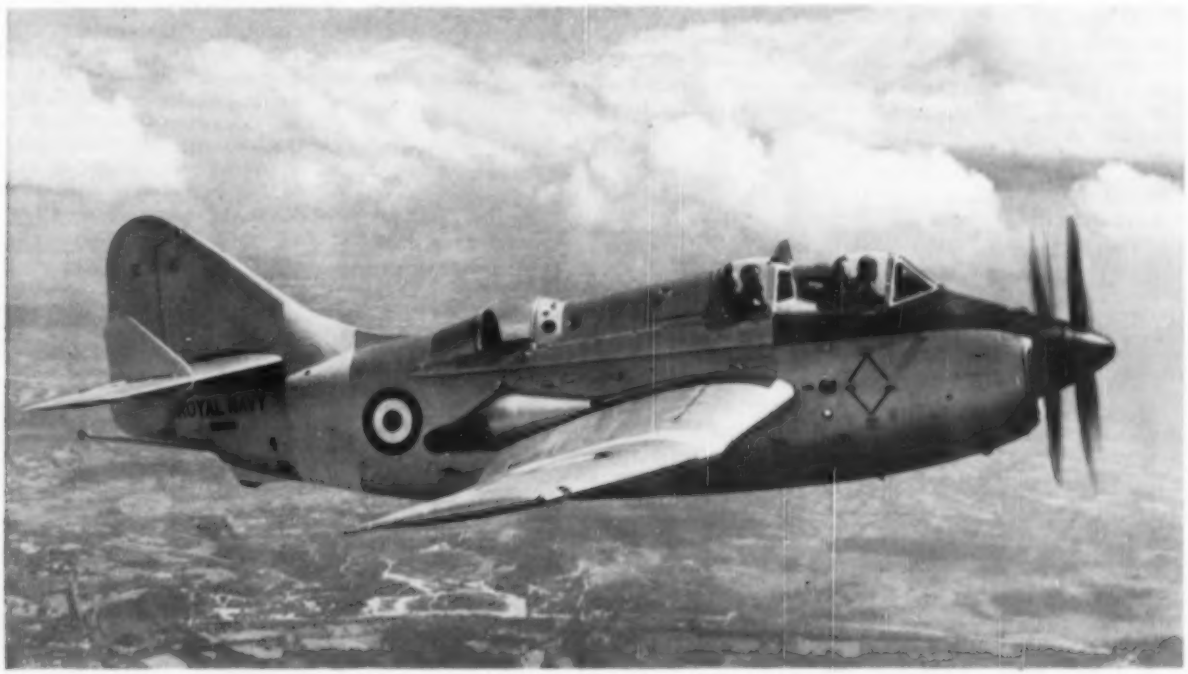
**North American Aviation's** Columbus Division is producing aluminum wall panels for commercial building applications. The company has firm contracts totaling approximately $400,000, and is furnishing curtain wall for commercial buildings in Hollywood, Calif., New York City and the Chicago area. Fabrication comprises bending, cutting and forming operations on aluminum sheet and aluminum extrusions, comparable production of tie-in steel work, and assembly of parts into complete curtain wall panels.

**Chance Vought's** F8U-1 Crusader will begin regular sea duty for the first time early next year. The aircraft will be operational with Navy Fighter Squadron VF-32, which will go aboard the USS Saratoga in the Atlantic. Shortly after VF-32 deploys, F8U-1A will go aboard the USS Hancock in the Pacific with Fighter Squadron 154.

**Kaman Aircraft Corp.** will produce H-43A and H-43B crash rescue helicopters for USAF. Multi-million dollar contract calls for initial deliveries of H-43As powered by Pratt & Whitney R1340 piston engints, later deliveries of H-43Bs powered by Lycoming T53 gas turbines.

**Hindustan Aircraft,** government-owned factory in Bangalore, South India, will produce an advanced version of the Bristol Orpheus 2 turbojet (AW Nov. 25, p. 51), according to Hindustan Aircraft engineers. The engines will be produced on a large scale before 1960 to power Hindustan Aircraft's first supersonic jet fighter, expected to fly in 1961, the engineers said. The factory is currently producing Folland Gnat fighters.

**Solar Aircraft Co.** reports sales and net income in the six months ending Oct. 31 exceeded that of the comparable first six months of the preceding fiscal year. Sales in the first half of 1957 were $43,328,300, compared to $34,157,800 for the same period last year. Net income for the first six months of Fiscal 1957 was $1,016,400, compared to a loss of $199,800 in the first six months of Fiscal 1956. Backlog as of Oct. 31 was $64,456,900, compared to $91,945,000 last year.




**Gannet Modified for Training**

Trainer version of the Fairey Gannet antisubmarine aircraft, designated the T. Mk. 5, has been developed for the British Royal Navy. Instructor sits in the second seat, but has the help of a periscope for visibility. Powerplant is Armstrong Siddeley Double Mamba turboprop.

**EXPLOSION** of shaped charges was photographed with Baker Super-Schmidt meteor camera at Sacramento Peak Observatory in New Mexico. Pellet track can be seen at upper right of the explosion. Camera is pointed almost directly towards the zenith.

# USAF Launches Artificial Meteors

**Bedford, Mass.**—Artificial meteors were launched from an Aerobee test rocket 54 miles over New Mexico, Air Force Cambridge Research Center revealed last week. The meteors were aluminum pellets blasted to a speed of 33,000 mph. by means of shaped explosive charges placed in the nose of the rocket.

At least two of the aluminum pellets are presumed to have maintained sufficient velocity to escape from the earth's gravity. Escape velocity is about 25,000 mph. The experiment will be used to obtain information on density, winds and temperature of the solar atmosphere.

### Research Program

Launching of the pellets is a part of the research program of the Geophysics Research Directorate of AFCRC and was under the direction of Maurice Dubin. Fabrication of the charges and setting up of the rocket was done by Professor F. Zwicky of the California Institute of Technology and Drs. T. C. Poulder and M. C. Wells of the Stanford Research Institute.

Launching was from the Air Force's Aerobee launching tower in New Mexico. When the rocket reached an altitude of 35 mi. the nose section containing three shaped charges was separated from the instrumented part of the rocket to preserve the instruments from the blast.

The nose section coasted to an altitude of 54 mi. where the charges were detonated. The blast was very bright, having an intensity approaching −10 visual magnitude.

It was observed at Mount Palomar observatory about 600 mi. away with a brightness greater than any other object in the sky.

**NOSE** of Aerobee rocket showing mounting of three shaped charges.

### Pellets Photographed

One of the pellets was photographed after the explosion. Its brightness was about −2 visual magnitude which is about as bright as Venus.

Other attempts have been made to fire artificial meteorites beginning in 1947 with V-2 rockets, but this is the first successful meteorite launching. Scientists at AFCRC are confident that such meteorites will be a very powerful tool for research into the physics of the upper atmosphere.

Firing of the artificial meteorites may also supply data useful in solving the re-entry problem of long range ballistic missiles.

# Technique Converts Heat to Electricity

**New York**—Technique for direct conversion of heat into electricity, which might find application in missiles and high-speed aircraft, was revealed last week by General Electric's research laboratory.

New thermionic converter, now in the laboratory stage, has conversion efficiency of about 8% but a figure of more than 30% appears possible, General Electric says. By comparison, conversion efficiency of a modern steam turbine-generator is around 40%.

Conversion efficiency of new device is roughly comparable to that obtainable with semiconductors and considerably higher than that obtainable using conventional thermocouples.

Conversion is accomplished by means of device which resembles a gas filled diode. When one of the elements, called the cathode or emitter, is heated to temperatures of around 2,500F, electrons boil off its surface and travel at high speed to the second electrode, called anode or collector.

Current then flows from the anode through an external load and back to the hot emitter. Ionized gas in the tube envelope is required to prevent build-up of space charge (electrons) which would otherwise block electron flow in the tube. Unlike conventional tubes, the emitter need not be coated with electron-emitting material.

General Electric's thermionic converter basically is a low-voltage source, producing about 2-3 v.d.c. under open-circuit conditions. Individual cells can be cascaded to produce higher voltages. Laboratory model has produced approximately 3¼ amp. per sq. cm. of emitter area, according to Dr. Wilson, but he hopes to raise the current density to approximately 10 amp/sq. cm.

**GE'S** thermionic converter.

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## Flag-raising day at another great new Olin Aluminum plant

Cradled in the heart of the Ohio River Valley, this expansive industrial giant is about to spring to life.

Ultra-modern from the ground up, this huge new Olin Aluminum Sheet Mill within a few short months will add its production to the vigorous mainstream of quality Aluminum flowing to the nation from four Olin Aluminum plants.

Flag-raising day at this giant new mill will mark an important new chapter in the exciting 22-month growth of Olin Aluminum. New ore ships, rolling mills, extrusion plants and wire and cable mills are already in operation or under construction. With these modern, fully-integrated facilities, Olin Aluminum is right now on the way to an initial annual volume of 340 million pounds of quality Aluminum. And that is only the beginning.

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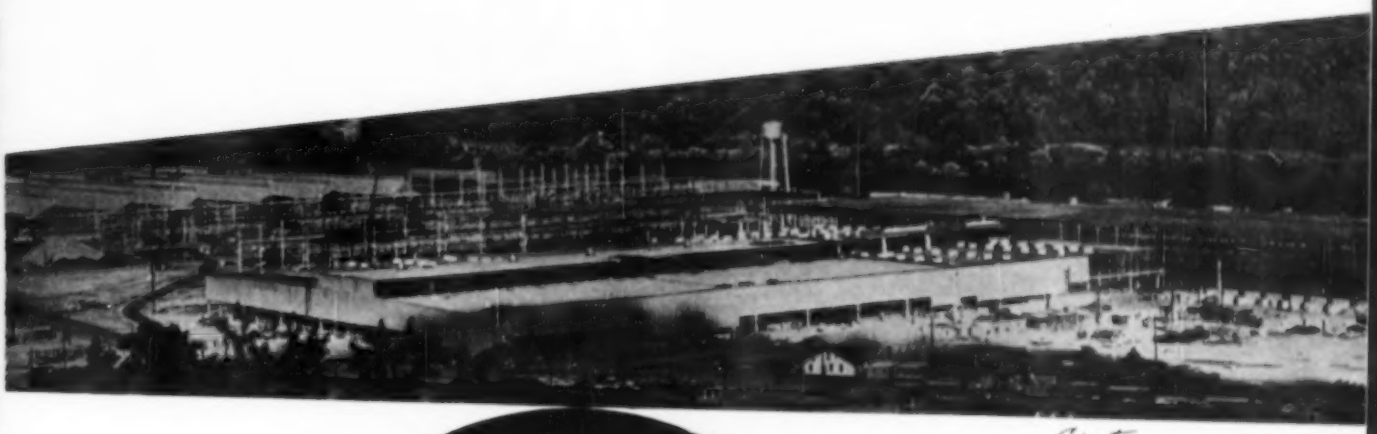

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Progress with TITANIUM

# New Titanium alloys

## *developed by Mallory-Sharon for the missile age*

Two remarkable titanium alloys developed by Mallory-Sharon's Research Laboratory further extend the usefulness of the metal in hot environments. This development promises more and more applications in rockets and missiles for titanium—strongest metal per pound of weight in its temperature range.

Commercial introduction of these new alloys culminates research and development over a two year period. In the intensive evaluation of both laboratory and production ingots, thousands of individual tests were made and analyzed. The results:

**The first** new alloy (MST 821) is a weldable sheet and bar material which offers strengths equivalent to similar titanium alloys—*at temperatures two hundred degrees higher*. This exceptional advantage is maintained in the range of 400 to 1000 degrees F.

**The second** new alloy (MST 2.5Al-16V) offers remarkable ease of fabrication for a high strength material. Sheet metal parts can be readily formed while the alloy is relatively soft, then can be heat-treated to high strengths. Heat treatment *more than triples* the strength level of this alloy.

As titanium's future in our air defense grows, it is likewise proving its economic advantages in new industrial applications. Let Mallory-Sharon, technical leader in titanium, help you *design ahead* with this new metal.

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*Producers of titanium and titanium alloy sheet, strip, plate, rod, bar, billets*

# Airlines Press for Financial Stature

**Carriers tell CAB of difficulty in finding money for new equipment as fare increase hearings continue.**

By Ford Eastman

**Washington**—Hearings in the General Passenger Fare Investigation move into their third week today as airline officials and financial experts continue efforts to prove that domestic airlines are poor competitors in the money market.

Largest portion of the time up to now has been taken up by American Airlines whose witnesses have been laying the groundwork for the airlines' contention that fares must be increased if they are to meet their obligations to the public and investors.

Airlines will take the stand in alphabetic order during the next several weeks, each presenting witnesses attacking the problem of competing in the money market from different angles. All 12 domestic trunklines in addition to the Air Transport Assn. will have an opportunity to be heard.

### Rate of Return Study

The hearings have been divided into three sections—consideration of rates of return, forecast of airline operations in the future and conclusions embodying other remaining issues.

Purpose of the testimony now being presented in the rate of return study is to prove to the satisfaction of the Civil Aeronautics Board that the financial standing of airlines is not strong enough to raise the sums of money necessary to move into the jet age.

Major reasons advanced by the industry for airlines' poor financial standing are:

- **Earnings have been spotty** and even in the best years have not been sufficient to compensate for the bad years. Presently, earnings are being depressed to a point where management is forecasting losses in the near future.
- **Rate of return on investment** and the operating profit margin are too narrow for an industry with the economic characteristics of the air transportation industry.
- **Present airline fares** are not high enough to permit earnings that will result in a fair and reasonable rate of return or a safe margin of profit.

Airlines differ on the rate of return necessary for each individual company but generally agree it should be in excess of 12%. American Airlines set the rate of return at 12%, a profit margin of no less than 7%, and, to gain that goal, witnesses testified that fares would have to be increased by 15%.

Typical of the difficulties facing airlines is American Airlines' own problem in completing its financing arrangements. Its witnesses said American has ordered 30 Boeing 707s and 35 Lockheed Electras to complete the first phase of its transition to turbine aircraft. To finance this, the company borrowed $135 million without too much difficulty. However, to go into the second phase and buy 15 additional long range jets and 25 intermediate range planes an additional $200 million will be required. It estimated that $100 million would be needed from outside sources.

At the time the financing was arranged for the first phase, the company assumed that its earnings would not fall below the $18-$20 million level for any year through 1960. These earnings, it said, would permit the equity base to increase so that during the peak period in 1959 the debt would be 49% of its equity. Financial witnesses said this ratio is in line.

### Earnings Trend

Under those conditions, American felt it could offer 15% more stock on the open market to not only increase its equity base further but to raise approximately $30 million in cash. Then, through the increased equity, the company felt it could borrow $75 million to reach the $100 million total without exceeding the debt-equity ratio rule.

Now, American said, the downward trend in earnings has completely changed the picture. The market value of stock has dropped and the equity base will not assume the proportion expected. Therefore, even without additional borrowing, the debt-equity ratio will be too high to raise any substantial sum through borrowing. Also, the money that could be raised through equity financing will be greatly reduced.

Financial experts told the CAB that prospective investors are concerned primarily with what they will receive in return for the use of their funds. If a company's earnings are not sufficient to retain a fair portion and still pay out dividends, then the investor will look for one that will.

The role that profits play in a private enterprise economy was outlined by one of American's last witnesses, W. B. Hickman, American Airlines assistant vice president for economic research.

### Earnings Study

High and stable profits which generate internal funds for expansion also are a necessary condition for generating external financing, he said. Conversely, low or unstable profits reduce the flow of funds for internal financing and discourage external financing.

Hickman introduced a comprehensive study of the earnings records of 195 corporations which American must compete with in the financial markets for new capital. He said the study of the corporate earnings records, when chartered, showed that earnings of American Airlines fell in the group with low and unstable earnings.

American Airlines earnings, he said, place it in a group of industries, such as the tire and rubber industry and paper products, which has been inherently unstable because of difficulty in controlling inventories. He added that American's earnings have been subjected to more violent gyrations than all except the two boom-bust industries—aircraft manufacturing and automobiles, but that investors in those two industries were rewarded for taking the risk of instability by an extremely high average level of earnings.

Hickman said the major cause of the instability of airline earnings is that profit margins are extremely narrow in a mass, high-volume operation. Any upward pressure on costs, or any slight hesitation in the rate of growth of

### Petition Denied

**Washington—Petitions of five domestic trunk air carriers requesting reconsideration in the Suspended Passenger Fare Increase Case have been denied by the Civil Aeronautics Board. The airlines had applied for fare increases amounting to 6% which the CAB turned down last September. The CAB said its action does not affect the pending General Passenger Fare Investigation which is currently under way before a CAB examiner and covers the entire domestic trunkline fare level.**

**Airlines asking for reconsideration in the Six Percent Case were Capital, Trans World, United, American and Northwest.**

earnings, quickly converts earnings rates that might be reasonable in a stable industry into losses that are intolerable in an unstable one.

Nelson Lee Smith, American vice president for economics and the airline's final witness, said new and imaginative approaches by the CAB to the problems facing the airline industry are imperative if the regulatory agency is to match the strides which the industry itself is making in technological advances and public service.

Smith said that traditional approaches and methods developed in the fields of conventional public utility regulation are not applicable without substantial modification to the air transport industry, which resembles much more closely the unregulated areas of business enterprise.

Regulated public utilities, as opposed to the airlines, he testified, enjoy a much more sheltered position insofar as the hazards of doing business and its fluctuations are concerned.

In contrast to the stability of the market for standard utilities—gas, electric and pipe line companies—airlines on the other hand must deal with travelers who first decide whether or not to take a trip; then by which means of available transportation (rail, motor carrier, private automobile or air) and finally which airline to take if the trip is by air.

# Eastern Letter Gets CAB Warning

**Washington**—Eastern Air Lines was warned last week by the Civil Aeronautics Board that attempts to "sway the Board's judgment" in pending cases by matters not brought out in regular hearings will not be tolerated.

The Board said it issued the warning after receipt of a copy of a letter written by an Eastern vice president that, it said, appeared to be an attempt to influence a Board decision.

The letter, according to the Board, was written by Robert Ramspeck, Eastern vice president in Washington, and directed to Bruch & Co., a Minneapolis stockholder. It set forth the nature of Eastern's application in the Chicago-Milwaukee-Twin Cities case, the Board said, the benefits to be received from an award of the new route authority sought and pointed out that hearings in the case had been concluded.

The Board said the letter specifically suggested that the recipient might wish to write to its congressman and senators, or directly to the examiner conducting the proceeding, urging that Eastern's application be granted. The Board said it assumed that the letter constitutes part of a planned program to solicit Eastern's stockholders in an effort to elicit support.

In a letter to E. V. Rickenbacker, Eastern board chairman, CAB Chairman James Durfee said:

"We recognize, of course, that all applicants before the Board have the right to acquaint their stockholders and other interested persons with the facts and the merits of their applications and to the practice governing proceedings in which those applications are to be heard and acted upon.

"However, in our judgment, activity of the sort with which we are here concerned is not a permissible one and goes beyond the bounds of propriety. It is in substance the solicitation of efforts by non-parties to sway the Board's judgment on the basis of non-record considerations."

CAB said that, in 1956, the Board directed a letter to Ramspeck concerning Eastern employes circularizing materials purportedly designed to enlist the assistance in persuading the Board to change its decision in the Florida-Texas case and requested cessation.

"In view of the nature and repeated character of Eastern's action deemed contrary to the Board's principles of practice," the letter read, "the Board believes that appropriate steps should be taken by Eastern's board of directors to guard against any further recurrence of similar incidents."

**Production Moves Ahead for Boeing 707**

First Boeing 707 production airplane (upper left) has acquired markings since recent rollout and the second and third airplanes are near completion. First airplane, which will make its maiden flight this month, will be turned over to the Civil Aeronautics Administration initially for certification tests. Next two, also destined for delivery to Pan American Airways later, will participate in these tests. All three are model 707-120 powered by Pratt & Whitney JT3 (J57) turbojets. Production has begun on the number seven airplane, the first of an order for 30 from American Airlines. First Pan American deliveries are scheduled for late 1958. American will get its first airplanes in 1959.

**RECTANGULAR** layout of Los Angeles International Airport plan (top) has concession building in center, spider walkways leading from it to ticketing buildings. Beyond on ramp are satellite loading buildings, connected underground to ticketing buildings (bottom).

# Los Angeles Starts Jet Age Terminal

**Los Angeles**—Construction of a $46 million jet-oriented passenger terminal at Los Angeles International Airport begins this month and is expected to be completed in January, 1960 (AW Nov. 4, p. 45).

Work will be speeded to meet an increasing traffic load, and in anticipation of jet transports. Present figure of 842 daily aircraft movements is expected to rise to 1,000 daily by the opening date.

New passenger terminal area, covering 265 acres, is expected to accommodate 9 million passengers in 1965 and 13 million in 1970, with provisions for even further expansion. Layout consists of a rectangular arrangement with airline terminal buildings located around the perimeter operating as independent units.

One story below airfield level in the center of the rectangle are roadways and a 48-acre parking area for 5,000 cars—an additional 2,400 auto parking spaces over present facilities.

This can be expanded by double decking.

Over the center of the rectangle, a restaurant and concession building will be elevated to afford an overall view, with spider walkways to the parking area and terminal units. Included in this center complex will be a main restaurant and cocktail lounge, employe cafeteria, shops and services for the public. Final design of this restaurant complex awaits decision of the airport commission and concessionaire.

Each airline will have a ticketing building serving as a check-in point for passengers and baggage.

Large signs denoting the specific airline will direct passengers to check-in points.

Underground passages for passengers and baggage lead from the ticketing area to satellite buildings located at the aircraft loading area.

Each satellite, serving as a public lobby and takeoff loading point, will contain waiting-room areas, a restaurant and cocktail lounge, newsstand and other service facilities.

Scheme for separating ticketing and baggage operations (located in ticketing buildings) from lobby and passenger services (in satellite buildings) relieves the congestion encountered in air terminals today.

Six satellite buildings are included in present plans, with provisions for a seventh as traffic demands increase. Each satellite has 10 plane-loading positions, each able to accommodate jet transports. Elimination of a finger concourse through the use of satellites allows flexible taxiing movements of 360 deg. around each loading unit.

Each satellite has two floors enclosing 74,000 sq. ft., which can be expanded 50% by adding a mezzanine. Each unit has a service elevator, escalators and stairways.

Underground passageways give passengers maximum protection from aircraft noise and blast, and weather. Passenger parks his car underground near check-in point and remains at this lower level through ticketing and baggage operation. He walks through passageways into satellite, where he is brought to satellite lobby level via escalator for loading. Average walking distance from entering terminal to airplane loading is one block.

At the airport entrance, a 150-ft. con-

**PASSENGER** channel leads into satellite building around which planes are parked for loading. Other channel from ticketing to satellite building may handle baggage by cart, train or conveyor belt.

trol tower will also serve as an identifying marker. Upper stories within the tower will contain seven floors for Civil Aeronautics Administration personnel and equipment.

Lower levels of the tower will be offices for the Los Angeles Department of Airports.

Constant transportation around the entire complex is planned, using a low-cost transportation system to be operated by a concessionaire.

Estimated total improvement program will cost $46 million, including $37 million construction costs plus land acquisition, engineering and inspection fees.

### Airport Plan

Construction schedule:

• **Construction will be** done in four phases. Phase I, costing $2 million, will begin immediately and will include construction of new east-west runway and taxiway and external service roads, relocation of department of airports present maintenance yard, and development of maintenance area for joint use by smaller air carriers. East-west runway will be 8,925 ft. initially, with provision for lengthening to 10,000 ft.

• **Phase II will begin** about May, 1958. Cost of this phase is estimated at $5,536,508, includes grading of north and south aprons, excavation of center rectangle, construction of underground passenger and baggage channels, underground utilities, water and sewage systems, drainage, reinforced concrete retaining walls, lengthening of existing north-south runway to 6,754 ft.

• **Phase III, costing** approximately $21,879,585, is scheduled for contract award in September, 1958, includes construction of ticketing and satellite buildings, central area buildings, including main restaurant and cocktail lounge and control tower. Construction will be completed in January, 1960.

• **Phase IV, costing** about $7,266,281, is to be contracted in February, 1959, and completed in December, 1959. This includes paving of aircraft aprons, parking area and internal roads. Lighting for aircraft aprons and streets also will be included.

More than 1,500 workers will be employed by contractors in the expansion program.

## United Places Order For DC-8s, 707-720s

**Washington**—United Air Lines is ordering an additional 10 Douglas DC-8 long-range jet transports plus 11 of Boeing's recently announced 707-720 medium-range jets (AW Nov. 25, p. 45) for 1960 delivery. The orders, marking the second phase of United's re-equipment program, will bring the airline's jet fleet up to 51 planes, including 30 DC-8s already on order for 1959 delivery, at a total cost of $275 million.

Boeing says the new four-engine 720 will be capable of cruise speeds above 600 mph. and will carry 100 to 125 passengers. It is to be powered by a new, lightweight version of the Pratt & Whitney JT3, commercial version of the J57, with a dry thrust of over 12,000 lb.

United said the 720 will have a maximum takeoff weight of 203,000 lb. and will require shorter airport runway lengths than the long-range 265,000 lb. DC-8. It is scheduled to be capable of operation into and out of any airport now served by United's piston-type DC-7 fleet.

United President W. A. Patterson said the 40 DC-8s will meet the airline's long-range requirements for the next several years. "As we crystallize our plans for the equipment required to convert entirely to turbine aircraft," Patterson said, "more intermediate units will be added in the intervening years to phase out the remaining medium-range piston aircraft."

United said it expected its third jet-age stage will be an order for aircraft for its short-range segments. This order, it said, will be postponed until after the long and medium-range equipment programs are well advanced.

The company arranged financing totaling $150 million in 1955 when it placed its original order for 30 DC-8s. Patterson said arrangements are being completed for an additional $100 million in the form of bank credit from a group of banks headed by the First National City Bank of New York.

## Continental Air Plan Offered by CAA

**Washington**—Civil Aeronautics Administration yesterday opened the continental airspace above 24,000 ft. to air traffic control service on an optional basis.

Previously, the CAA had offered traffic control service only on the 100,000 miles of designated federal airways and around some major terminals. Over the remainder of the airspace pilots had to rely entirely on "see and be seen" method as means of separation.

Commercial airlines now seldom fly at the 24,000 ft. or above altitude and will have little opportunity to take advantage of the CAA traffic control system until after the introduction of jet transports. At present, the program will primarily benefit the substantial volume of military jet traffic already utilizing the airspace above 24,000 ft.

CAA pointed out that handling of the military traffic will give the agency an opportunity to gain operating experience and time to install more facilities and train the people required for the more comprehensive control program that will be needed when the commercial jets arrive.

Control of airspace over 24,000 ft. is the first stage of a three-part, long-range program. The next step will be the lowering of the floor of the continental control area to 15,000 ft., reaching levels now used by pressurized civil transports, but with control still on an optional basis. This is expected to become effective by next spring.

CAA Administrator James T. Pyle says the CAA hopes to have the equipment and personnel capability for control of all aircraft at high altitudes over the U.S. by 1962. By then, many civil jets are expected to be in operation.

# Rickenbacker Caustic on Fares, Wants 15% Stopgap Rise Now

**New York**—Airline industry stocks are "a good short sale," members of the New York Society of Security Analysts were told by E. V. Rickenbacker, chairman of Eastern Air Lines.

Rickenbacker called for an immediate granting by Civil Aeronautics Board of a 15% fare increase in standard passenger fares pending the outcome of the General Passenger Fare Investigation.

This stopgap increase, he said, is one elementary step the Board can take "to bring our badly listing industry back on an even keel with power enough to move ahead . . ."

### Deteriorating Position

Otherwise, the Eastern chairman warned, it will take at least a year for the "laborious procedures" to be completed and no one can tell what position the airlines will be in by then. He suggested that "many more times 15% might be required to restore the carriers to health if present conditions are allowed to go uncorrected."

Regarding the pace of the hearings, Rickenbacker remarked that "at the rate they're going, there won't be many of us left" by the time the decision is handed down.

An enormous mass of briefs is being filed with the Board, he said, "which, incidentally, none of them will ever read."

After all the "toil and turmoil" of a year's hearings, Rickenbacker said, the Board could arrive at no better solution than the one that is available to it today—i. e., to grant the 15% increase.

### Unthinkable Alternatives

The Eastern official expressed his confidence that the board will approve the increase in passenger and cargo tariffs. He said the "obviously unthinkable" alternatives were:

• **Cutbacks** in orders for new aircraft. This would cause a loss of millions to those carriers who have made down payments and would "deal a critical blow to aircraft manufacturers who, at this very time, are faced with tremendous problems of their own having to do with vital national defense of our country." It would also injure the public, disastrously affect the nation's industry and commerce, give foreign-flag airlines a competitive edge, and cripple the airlines' contribution to national defense.

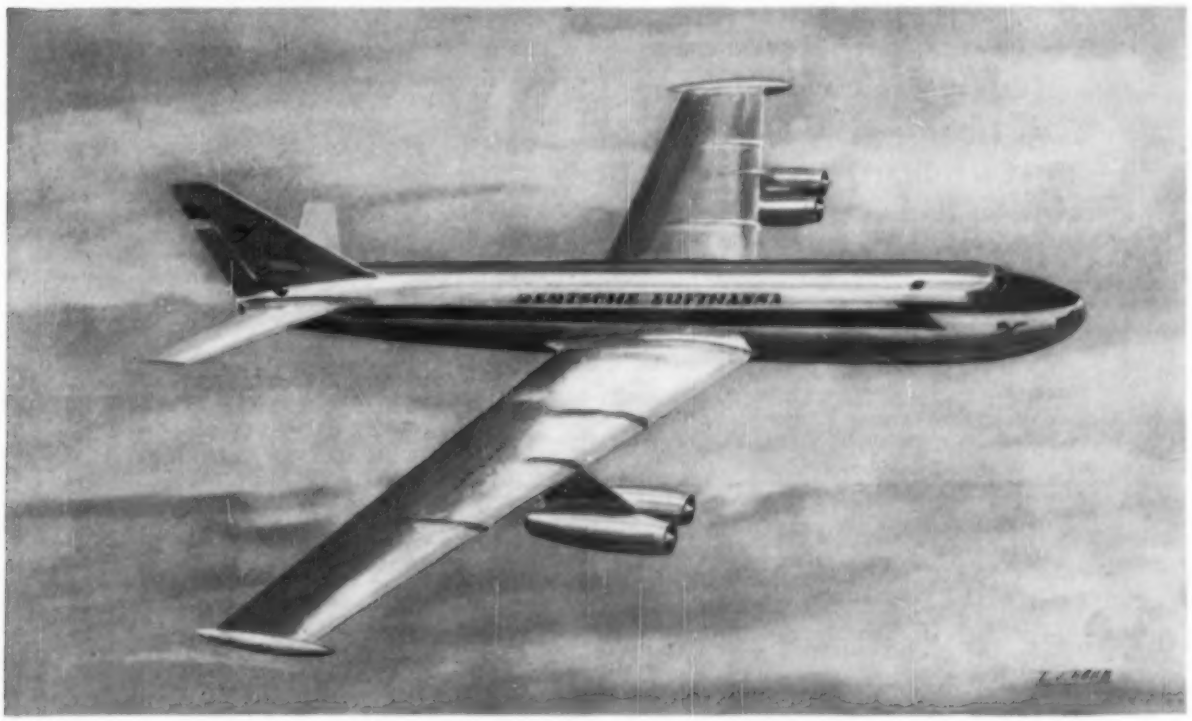
• **Tapping** of the public treasury to put the airlines back on subsidy. Capital Airlines' request for subsidy may well be followed by others if relief is not forthcoming fast enough. The bill would amount to a minimum of $250 million a year "just to start with."

• **Reduced operations.** This would mean a cutback of 20% of the services now available to the public. Rickenbacker also suggested that safety might suffer through lowered servicing and maintenance standards. "Today it is unthinkable," he said, "that any action—or lack of action—by any governmental department could force upon the airlines any such desperate measures that would jeopardize the public safety."

The stopgap increase, Rickenbacker said, would do more than anything else available to the industry to help the airlines recover financially. Also, it would help restore investor confidence in the industry.

In replies to other questions by the analysts, he said:

• **There will always** be a market for




## East Germany's Jet Transport

East Germany's medium range jet transport, reportedly designated the Baade/Bonin B-152 (AW Nov. 4, p. 41), is depicted in this drawing. The 40-70 passenger aircraft, conceived, developed and under construction by the East Germans, is expected to be completed next May. It will cruise at 500 mph., have a 1,500 mi. range, and its four jet engines will develop more than 27,000 lb. total thrust. Designers say the plane will be capable of achieving a takeoff run of only 2,620 ft. with a full load. Similar planes require about 4,000 ft.

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used aircraft, but it will be "up and down" in the future.

• **Use of the operating** ratio formula, rather than the rate of return, would not encourage inefficiency because it would be guarded by competition.

## Subsidy Payment Boost Predicted by CAB

**Washington**—Slight increase in subsidy payments for air carrier operations is predicted by the Civil Aeronautics Board for Fiscal 1959 after annual declines since 1954.

Total subsidy accrual for 1959 is estimated at $40,728,000 as compared with $40,612,000 for Fiscal 1958. Air carrier subsidy for Fiscal 1957 is estimated at $41,110,000. It was $43,792,000 in Fiscal 1956; $45,785,000 in 1955, and $64,309,000 in 1954.

In its annual service mail pay and subsidy report, the CAB said subsidy estimates for local service carriers constitute more than 70% of the total requirements for 1959. This does not reflect the impact of route awards which may be made in proceedings now being processed by the Board. CAB said new route awards and re-equipment programs could increase the estimate by as much as $6 million.

Besides the local service carriers, the Board said the major portion of the subsidy estimated for 1959 will be required by helicopter operators and the carriers providing Alaskan services.

Local service requirements are estimated at $29,722,000; Chicago, New York and Los Angeles helicopter operators at $4,418,000; States-Alaska operations at $2,278,000; Intra-Alaska Operations at $3,529,000, and Latin American operations at $781,000.

All domestic trunkline operations are expected to be subsidy-free in Fiscal 1959 as well as all international operations except Braniff's Latin American service. The two carriers operating in the Hawaiian Islands became subsidy-free during Fiscal 1957.

The service mail pay for all carriers in 1959 is estimated at $73,214,000, an increase of more than $4 million over 1958 estimates. Ton-mile rates for each carrier are generally the same as estimated for 1958 and 1957. Expanded service and increased mail account for the increase in payments.

## Allegheny Sets Record For Traffic in October

Allegheny Airlines flew 12% more passenger-miles in October than it did in the same month of last year. Total was 7,181,700. The 1957 performance was an October record for Allegheny. Increase during the first ten months of 1957 has averaged 18%.

# AIRLINE OBSERVER

► Airlines are becoming victims of a tight squeeze play as the result of the growing battle between Air Line Pilots Assn. and Flight Engineers' International Assn. over the composition of jet transport flight crews (AW Nov. 18, p. 43). Opposition between the warring unions as to whether third crew members should qualify as pilots or professional flight engineers threatens to delay inauguration of jet transport service. Air Lines Pilots Assn., irked that Pan American has signed a contract with the Flight Engineers' Assn. providing for flight engineers on jet transports, has declared pilots will not fly the jets until they are brought into consultation with the company on the make-up of jet crews. Pan American will receive the first of the Boeing 707 turbojets in late 1958 or early 1959 and the Flight Engineers' contract runs until June, 1960.

► **At least one international carrier regrets having contracted for summer transatlantic charter flights because of early signs last spring that passenger traffic would experience a sharp decline. As the volume of traffic began to reach for new heights despite the late start (AW Oct. 28, p. 38), the carrier sought to cancel its contracts in hopes of benefiting from the unexpected surge in business.**

► Airlines have been forced to ask for a fare increase because of too much competition according to United Air Lines President W. A. Patterson. He said United's San Francisco-New York non-stop flights are operating at load factors about 14% short of the break-even point because of "too much competition" and added: "There would be no need for a fare increase—or at least, for an increase as large as the one we're asking for—if the Civil Aeronautics Board had not created more competition than is necessary."

► **User charges on airports, airway and navigational facilities and meteorological and rescue services in Australia will be increased by 10% Jan. 1. The Australian government is also establishing a committee to settle disputes on domestic fare structures, routes, freight rates and scheduling.**

► Watch for some railroads to charge, in support of new requests for fare increases, that they cannot compete with subsidized airlines without operating in the red. Railroads already are saying that past government aids to railroads were of a different character from those extended to scheduled airlines today and that the airlines are receiving direct assistance for which no repayment is expected. Railroads, they say, received land grants, in return for which they carried government mail, freight and passenger traffic at reduced rates. Second form of government aid, railroads say, came in the form of loans which were repaid plus interest totaling $375 million.

► **Air cargo traffic leveled off slightly in October after climbing consistently during the first nine months of the year. Despite the lack of improvement in November, scheduled airlines will still show a 25% increase in air cargo traffic volume for 1957 over the previous year.**

► Capital Airlines will attempt to renegotiate its loans covering the purchase of 60 Vickers Viscounts. High interest rate—6¼%—on loans payable in monthly installments over a five year period is chief cause of the carrier's present critical financial condition. During the first nine months of the year, Capital showed an operating income of $1,099,378 and gained $479,410 on the sale of aircraft. However, interest expense of $2,862,476 caused a net loss for the period of $1,248,861. The loan is covered by equipment purchase notes issued under the contracts with Vickers and Rolls-Royce.

► **Eastern Air Lines is forecasting a 40% to 50% drop in net earnings below those of 1956 when the airline showed earnings of $5.17 per share. Operating revenues will increase approximately 17% over 1956.**

► Air traffic controllers are giving strong support to Spanrad—superimposed panoramic radar display—as a radar-to-television technique with the most promise for effective display in traffic control. Controllers warn against the use of Volscan for civil purposes in its present stage of development. They charge that Volscan was designed to meet military, not civil needs.

# New School Expected to Enhance American's Bid for Stewardesses

By Craig Lewis

Ft. Worth—American Airlines has opened an elaborate stewardess training facility here, and the handsome new school gives American a favored position in the increasingly intense airline competition for women to serve on expanding transport fleets.

American's school is just the latest sign of the competition scramble the airlines have found themselves in over the past few years, trying to expand their stewardess forces to handle increased flight capacity while faced with the traditionally high turnover rate in stewardess ranks.

An American Airlines answer to the problem is the elaborate "College" built here to replace the old school at Chicago's Midway Airport. And the week-long dedication ceremonies held here last week left no doubt that this school is the apple of American management's eye.

A week of ceremonies ended when American's board of directors held its monthly meeting at the school before official dedication ceremonies.

Speaker of the House of Representatives Sam Rayburn headed the list of dedication speakers, and the first stewardess class arrived from Chicago to take over the school and go to work.

### Layout of School

American's Stewardess school is a rambling two-story structure built of West Texas fieldstone and set in a 22-acre wooded area across the road from Amon Carter Field. The $1 million facility has a swimming pool and tennis courts, and eventually it will have a pitch-and-putt golf course. The landscaped campus is enclosed by a chain link fence.

Lower floor of the school is designed in a colorful, contemporary fashion and includes four classrooms, a reception room, recreation area, cafeteria and kitchen, and a beauty salon. Upstairs, the girls live in 27 spacious rooms.

Most of the bedrooms are linked in suites of two rooms with bathroom facilities between them. Normal tenancy is four girls to a room, although they will handle five if necessary. Normal size of a stewardess class will be 120, but the school will take classes up to a maximum of 149 girls.

American figures it will turn out approximately 1,000 stewardesses a year at the new training facility.

If the need arises, the school can be expanded to handle larger classes. The U-shaped building can be closed with an extension on the fourth side, and some of the patio areas can be enclosed.

### Collegiate Atmosphere

The attractions of this collegiate approach to stewardess training should give American advantages in competition with other carriers for stewardess recruits.

It is a new symptom of the general competition for flight personnel which has been increasing as airline capacity and business has expanded.

One of the hazards that complicates expansion of present stewardess ranks is the high turnover rate. An average stewardess works about two years before she resigns, usually to get married. Last year, American trained nearly 700 stewardesses, most of them as replacements. The airline currently has about 1,400 stewardesses.

Qualifications have been liberalized considerably since the pre-World War II days when a stewardess had to be a registered nurse. A considerable amount of this liberalization has come in the past few years as the need for more women has become more pressing. Increase in aircraft size has contributed to liberalizing of some height and weight standards, but these wider standards also give recruiters a bigger labor market. American estimates it will interview more than 15,000 candidates for next year.

### Stewardess Qualifications

To qualify for a job with American, a girl should be between 20 and 26 and between 5 ft. 2 in. and 5 ft. 8 in. Weight restrictions are related to heights, but the maximum is 130 lb. Some college education is generally considered a minimum requirement for applicants.

Most carriers have requirements similar to these, and many of them have been broadened in recent years. And in some cases they aren't hard and fast rules if an especially promising candidate comes along. A high school graduate, for instance, can often qualify if she can show some attractive business experience.

When a girl goes to work for American, she gets free transportation to the Ft. Worth school, and the airline pays her expenses at the school, although no salary is paid until graduation. Currently, stewardess salaries range from $285 to $370.

American finds it costs about $500 to process a stewardess from first interview to first flight.

### Intensive Course

At the school, American puts the girls through an intensive 5½ week course which includes theory of flight, meteorology, airline routes and schedules, aircraft familiarization, first aid, meal service procedure and general passenger care.

The school is under the general direction of Superintendent Mildred Alford, a veteran of 10 years in American's stewardess training program. Supervisor of training is Miss Anne O' Conner.

Regular school day for the trainees is a nine to five affair, but Miss O'Conner points out that extra training duties absorb several evenings and weekends. Two weekends during the period are spent taking observation flights as passengers, watching regular stewardesses operate. And two nights each week during a three-week period, the students serve each other dinner on Convair, DC-6 and DC-7 equipment to practice what has been taught in meal service classes.

Several evenings are taken up with interviews with instructors to check progress and iron out any problems. And some evenings are spent in the beauty salon when American calls in hairdressers to style the usual short haircut to fit individual girls.

**AERIAL** view taken from a helicopter shows the new American Airlines stewardess training facility at Ft. Worth, Tex. Two story structure is flanked by swimming pool, tennis courts and eventually will have pitch-and-putt golf course.

## SHORTLINES

▶ **Aeronaves de Mexico** has placed an order for three turboprop Lockheed Electra transports. Six U.S. and five foreign airlines now have ordered a total of 144 Electras. Aeronaves is the first Latin-American carrier to place an order for the transport.

▶ **American Airlines** was to inaugurate daily "Captain's Flagship" luxury service yesterday between Detroit and New York. Similar service is now operated between Chicago and New York. Premium for the Detroit service is $3 and the airline plans special gates at each end for the flights.

▶ **Braniff International Airways** grossed $46.7 million in operating revenues during the nine-month period ending Sept. 30, an increase of 19.7% over same period of 1956. Net operating income was $3.45 million, a 1.5% increase. The airline's expenses for the period were up 22%. Revenue passenger-miles operated increased 22% to a total of 77,550,549.

▶ **Northeast Airlines** flew 69.6% more revenue passenger-miles during the first nine months of 1957 than during the same period of last year, the airline reports. The 1957 totals were 565,611 passengers and 157,480,000 passenger-miles. The carrier inaugurated its first Miami service in January. Total flights over its East Coast route to Miami as of Dec. 1 were to be 20 daily with a 1,520-seat capacity on DC-6Bs.

▶ **Pan American World Airways** reports third quarter gross operating revenues of $90,954,000 up from $84,659,000 in third quarter 1956. Passenger revenues were up 9.3% to $73,342,000, freight revenues were up 23.2% to $8,049,000. The carrier's expenses increased 11.4% while net income for the quarter was $5,990,000 compared to $6,708,000 in the same period of 1956. Subsidy in third quarter 1956 was $2.5 million, while no subsidy has been received since Oct. 1, 1956.

▶ **Transocean Air Lines** plans to put Lockheed Super Constellation equipment in passenger and cargo service between the West Coast and Okinawa Jan. 16. The supplemental carrier expects to schedule weekly flights with stops at Honolulu, Wake and Guam. Service has been provided with DC-4s.

▶ **Western Air Lines** earned $2,385,860 in net income during the first nine months of 1957. Current third quarter operating income was $2,093,816, up 15% from third quarter 1956.

# COCKPIT VIEWPOINT

**By Capt. R. C. Robson**

## Fire Brigade or Study Group?

It may sound silly, but it's true, that more and more the required fuel loads on aircraft are being computed not on the basis of weather or winds or alternates, but rather on the basis of probable traffic. Since traffic at any given time of arrival is even harder to forecast than the weather, this makes for considerable head scratching in the fuel planning department. With absolutely clear skies and unlimited visibility aircraft can, and on occasion actually do, experience delays up to 45 min. attempting to land at LaGuardia Field!

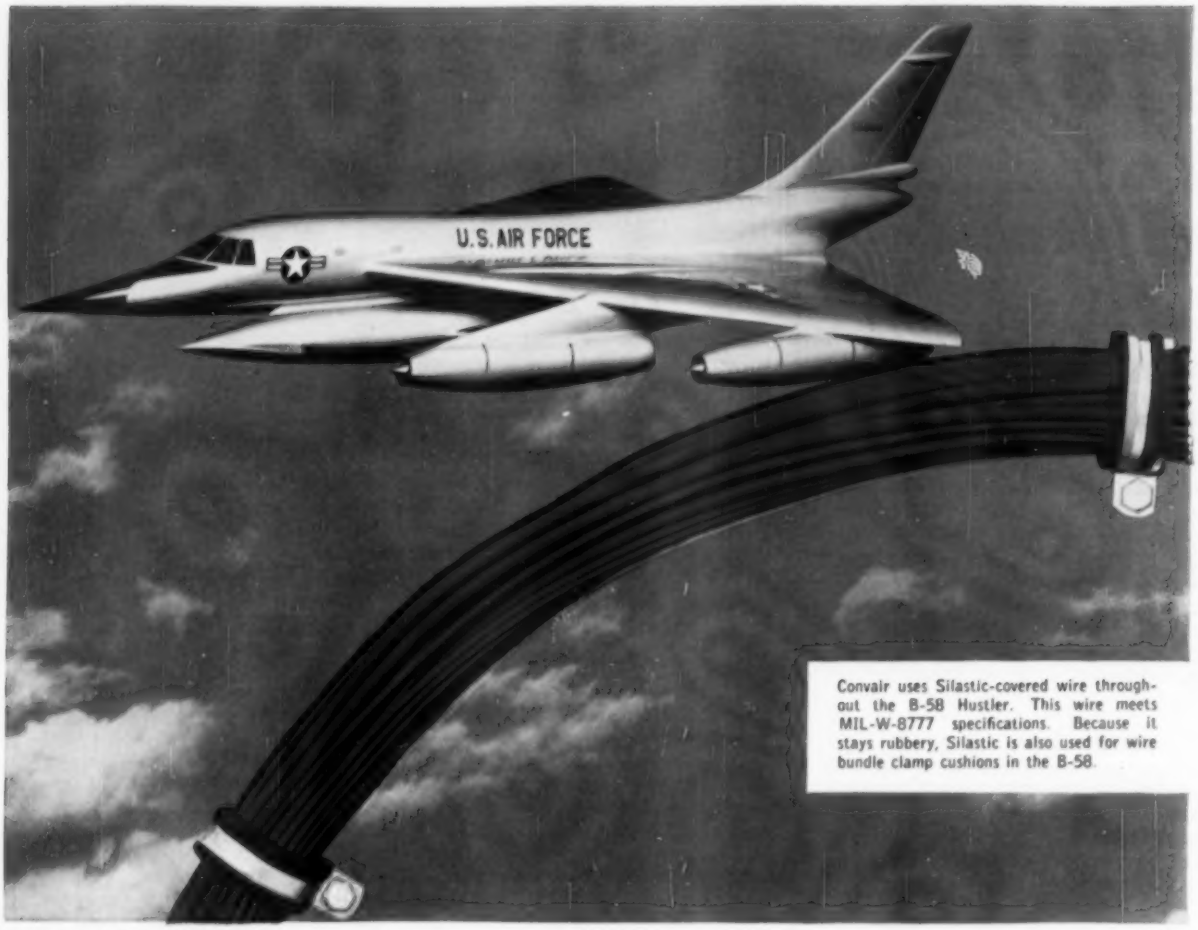
Such is the air traffic situation facing the newly created Airways Modernization Board. Obviously it must get down to serious business if it intends to make any real progress and we need progress but fast! No doubt this is why the AMB is beginning to let contracts for studies of various operational problems. We certainly would not want this agency to go off half cocked and act on misinformation.

On the other hand one cannot help wondering if AMB is going to fall into the trap of becoming merely another "study group." If there is anything we don't need it is another learned analysis at the expense of action. It does seem that there should be sufficient quantities of paper left over from the now defunct Air Navigation Development Board, from various groups of the Air Coordinating Committee, from Radio Technical Commission for Aeronautics and innumerable other places to acquaint people with the problem.

There seem to be two definite traps into which we continually fall. One is the appointment of another committee to study the problem. The air traffic problem has been studied ad nauseam. We have isolated the problem. We have identified the problem. We know what causes the problem. The only thing we never get around to doing is finding a solution. Committees seem to feel that "the report is the thing." Get out the report and everything will fall into place. But out at the local aerodrome one can hardly notice any results except more traffic and longer delays. Eventually committees learn with amazement that the problem they "solved" five years ago still exists.

The other common trap is that of "planning for the future." Few people seem sufficiently interested in doing something about existing conditions and existing traffic. It appears infinitely more glamorous to work on fancy gadgets for some future date. Right now we are all fired up about the high altitude, high speed problems of the jet. I would not for a moment attempt to minimize this situation but at the same time we should not overlook the airway and airport snarls that exist right now. The consequences of continually working on long range plans is that the "now"—today's problem—never gets solved.

The AMB has many fine people in its ranks with plenty of work available. It should not delude itself that it can get by merely with more studies. The very nature of its birth plus the possibility of a life span coinciding with that of the present Administration argues that it will have to show concrete results in short order. All signs point to an air traffic snarl of colossal proportions in the coming years. More passengers than ever before will begin demanding "on schedule" transportation, airlines stand to lose enormous sums, and business interests will lose their new found mobility. Tremendous pressure will be placed on those in office, and lengthy statistical reports will hardly be considered sufficient evidence for continued existence. As in a war, the winning of even a minor battle is of infinitely more importance than the production of a warehouse full of well laid plans. Unless the AMB can get into action and win a few battles in a hurry it stands a good chance of joining the ranks of other three and four letter organizations now gone and forgotten.

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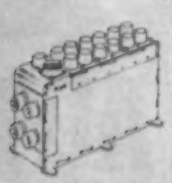

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# Radar Saves Money, United Finds

**New York**—Airborne radar is saving dollars as well as increasing passenger comfort and safety, United Air Lines has found in a study of its experience with the storm avoidance equipment.

The radar is paying for itself by reducing aircraft damage, delays, detours and other problems of flight during summer thunderstorm months, the study indicates. Comparing the months April through September 1955 before the $4 million radar installations began against those months of 1956 and 1957, United found:

- **Reduction in aircraft** damage resulting from hail or thunderstorm turbulence. This problem had previously cost United an estimated $400,000 annually.
- **Cases of static discharge** were reduced 65%. Cost of this item had been about $25,000 a year.
- **Turbulence incidents** such as landings at off line points or detours at reduced cruising speeds decreased about 80%.
- **Delays due** to such turbulence incidents grew shorter. These detours and reduced-speed operations had cost about $150,000 a year.

### Basis for Decision

According to the study, United's decision to buy the weather radar was based, in addition to safety and comfort factors, on an expectation of economic benefits. These have derived from the operating improvements mentioned plus increased passenger good will, schedule reliability, elimination of flight cancellations because of thunderstorm conditions, better flight crew morale and other intangibles.

The report points out that a full evaluation of the radar is impossible because of variables such as difference in thunderstorm frequencies and intensities from year to year. Nevertheless, United finds that "there is certainly some evidence of radar paying its own way economically."

Data for the study was obtained in part from more than 1,000 reports filled in by flight crews on special radar reporting forms. These include personal reaction information, and 90% of the reaction was favorable. Pilots reported such results as "would have turned back and landed" without radar, "would have detoured 300 miles south," and "flight through the area impossible without radar."

In its comparison of warm weather operations before and after radar, United noted 51 cases of static discharges in 1955. The next year, with its fleet 45% radar equipped, the cases dropped to 31. In 1957, with 95% radar, there were 18 cases.

Turbulence-caused flight delay of the airline's DC-6s amounted to an average of 276 min. per million miles flown in 1955, according to the study. This was down to 189 min. per million miles during the 1957 period.

The carrier's DC-7s averaged 101 min. of turbulence delay per million miles before any of them were radar-equipped. In 1957, with installation 65% complete, the average was 61 min. per million miles.

Flight crew response to the radar was 7% noncommittal, which the report ascribes to lack of need for radar on a particular flight, or to impossibility of getting air route traffic control clearance along a desired detour path.

### Reason for Disfavor

The report notes that unfavorable reactions, which totaled 3%, were usually connected with equipment malfunctions or inadequate understanding of the limitations of the devices. Mechanical reliability, however, is comparable to other equipment of similar complexity, according to the study.

United hopes to have its fleet radar installation 100% completed next month.

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# Railway Express Bid Opposed

**Washington**—Civil Aeronautics Board Examiner Edward T. Stodola has recommended against a bid by Railway Express Agency to act as an international air freight forwarder and general agent for certain direct air carriers.

Railway Express proposed to operate as an international air freight forwarder between the U.S. and overseas and foreign points except Alaska, Hawaii, Canada, Cuba and other overseas and foreign points to which it now operates under the domestic air express agreement. In addition, it asked approval of general agency agreements with Seaboard & Western Airlines, Transportes Aereos Nacionales (TAN) and Impresa de Transportes Aerovias Brasil (REAL).

Stodola said there is no doubt that Railway Express could provide a useful new service. He agreed that the agency is in a position to generate much new international cargo; that its transportation services are not available elsewhere on the same scale, and that an air freight forwarder authority for the agency in combination with its existing facilities would provide wider solicitation coverage, faster service and other advantages of Railway Express' integrated air-rail service resources.

"But," Stodola added, "more aggressive merchandising and superior service is not enough. There are countervailing considerations, not the least of which is that the size and strength of REA's solicitation facilities and service resources would give it an undue competitive advantage.

### Interest Conflict

As an international air freight forwarder, the examiner said, Railway Express would in time become subject to serious conflicts of interest with its international surface forwarding activities.

He said Railway Express at present offers a world-wide surface forwarding operation by water through arrangements with various companies in foreign countries. The agency also has a surface forwarding arrangement with the American Express Co. which functions as a surface forwarder. On some small shipments, air freight rates internationally are not higher than the rates of the American Express Co., he said.

Under certain circumstances, Railway Express would have to weigh the incentives for promoting international air cargo as against routing such cargo via ocean carriers, according to Stodola.

As the cost of air transportation decreases with technological advances, he said, the area of competition between air and ocean carrier transportation will progressively increase.

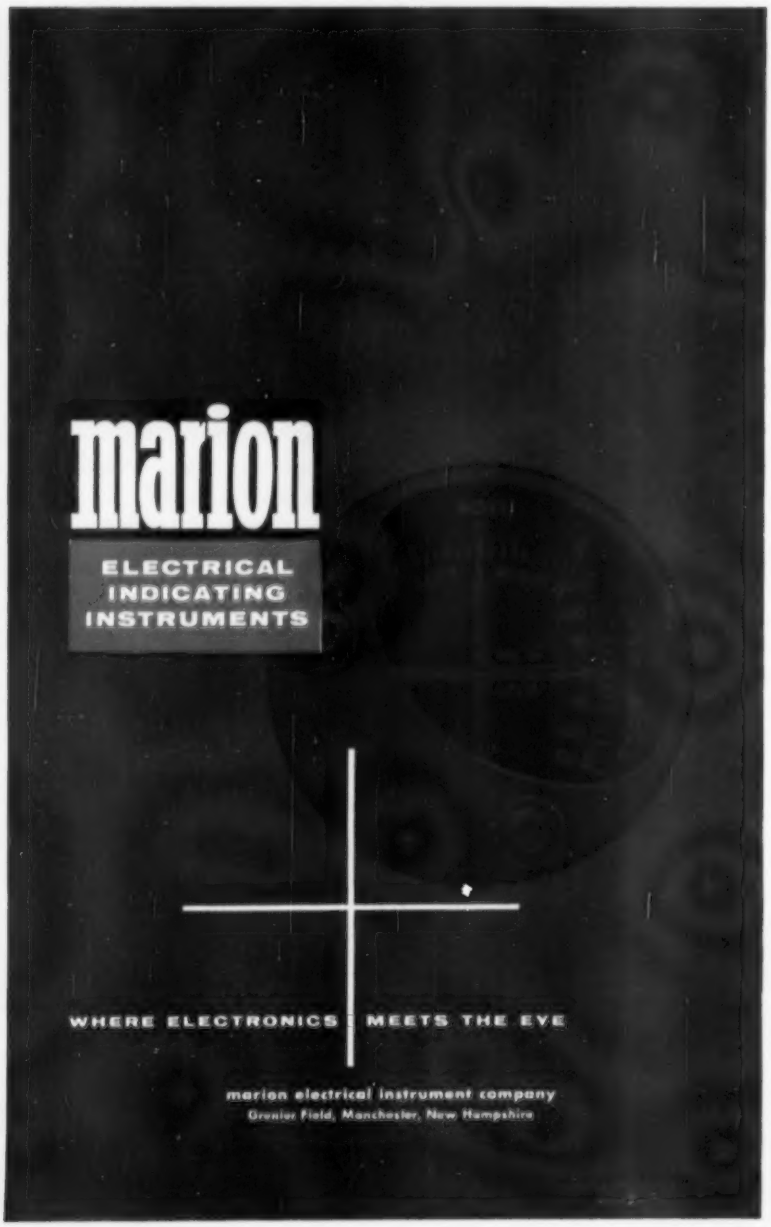
Domestically, he said Railway Express is acting in the conflicting capacity of promoting both air and surface cargo services. Control of the agency by the nation's railroads, he added, has exposed it to divergent loyalties because, as a rail express company, it is promoting rail express at the expense of air express and air freight. He added:

"The proposed authorization of REA also raises other considerations of the possible wider railroad influence on air freight transportation and the extent to which such influence may be detrimental to the full development of air cargo transportation.

### Service Distinction

"It is one thing for the individually-owned air freight forwarder who has several means of transportation available in his forwarding operations to use rail service in conjunction with air service in moving cargo; it is another matter to enlarge the services of a company wholly owned by the railroads for greater opportunity to promote rail express at the expense of air freight."

Stodola said the amount of air cargo handled by Railway Express is much greater than the total air cargo tonnage handled by all of the international air freight forwarders combined.



# All-weather flight for Helicopters

## Sperry Announces Advanced Developments in Controls

To increase the all-weather capability of helicopter flight has been a continuous research and development program at Sperry. The newest development is a Stabilizing Control System adaptable to all types of rotary wing aircraft.

This new miniaturized electronic system is designed for partial or fully automatic control to achieve stability during take-off, in flight, hovering and landing – in varying conditions of wind and weather. Use of transistors, redundant amplification and rugged miniaturized components, engineered with traditional Sperry precision, give the new system great accuracy and reliability–all within small space and light weight for either the minimum or fully automatic system.

**CHIEF BENEFITS OF THE NEW SYSTEM ARE:**

**Reduction of pilot fatigue.** Constant stick handling is eliminated.

**Accurate navigation.** Precise flight is achieved even under conditions of poor visibility and over unfamiliar terrain.

**All-weather flight.** Automatic system provides hands-off stability needed under all flight conditions.

**Control stick steering.** The pilot generates command signals by moving stick in conventional manner.

Other Sperry developments for helicopters include a new Sperry All-Weather Integrated Instrument System. Providing simplified display of all data for manual control, it includes Flight Director Computer, Horizon Flight Director Indicator, Navigation Computer, Compass Pictorial Displacement Indicator, Altitude Vertical Rate Indicator and RPM Control System (also available individually). If you have a requirement in helicopter controls and instrumentation, write our Aeronautical Equipment Division.

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**ROTODYNE** can carry a 10,000-lb. payload or 40 passengers in its present configuration. Noise suppressors are being tested on tip jets.

# Rotodyne Built for Short-Haul Routes

By David A. Anderton

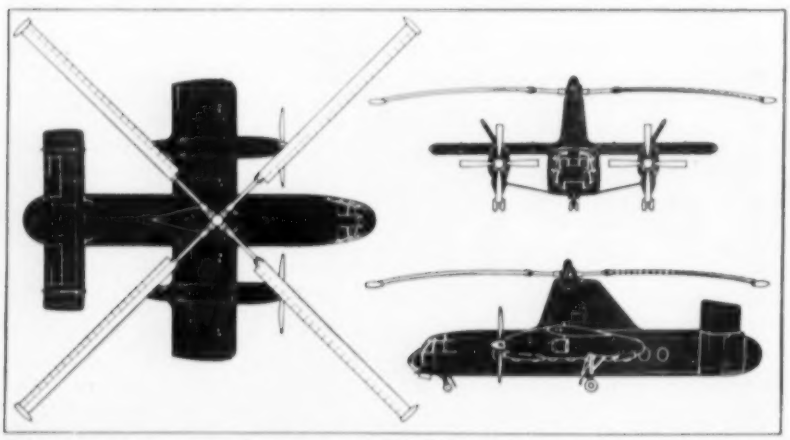
**White Waltham, England**—Fairey's Rotodyne, now in the early stages of its flight test program here (AW Nov. 18, p. 37), has been designed to beat both helicopter and fixed-wing transports on short-haul routes.

Rotodyne is a twin-engined airliner which combines helicopter takeoff and landing performance with the cruise economy of a fixed-wing airplane.

In its present configuration it can carry a 10,000-lb. payload or 40 passengers.

Design stage lengths of the Rotodyne with final developments of its Napier Eland gas turbines are approximately 450 mi.

A larger fuselage will also be available for future models, to increase the passenger capacity to 50 and the cabin head height from the current six-foot level to eight feet.



**ROTOR** has 90-ft. diameter; cabin head height is 6 ft. Fixed wing has constant chord.

Major importance of the Rotodyne will lie in its ability to operate from city-center to city-center with a large payload. The vital and highly competitive route from London to Paris now takes more than four hours by the fastest way available and on occasion can grind on to five hours, or an average speed of about 42 mph. Fairey says the Rotodyne can reduce this to less than two hours with an allowance of 30 min. for passenger handling and a 15-kt. headwind figured in.

## Noise Level

One criticism of the design has been voiced: noise level of the pressure-jet drive system. Observers at Farnborough a couple of years back when the Jet Gyrodyne test vehicle was demonstrated were shocked by the high locomotive-like noise level (AW Sept. 12, 1955, p. 17).

Since then Fairey engineers have made considerable progress in development of a noise suppressor. With units now available, the engineers say, Rotodyne should be no noisier than current twin-rotor helicopters at takeoff. After takeoff, the noise level of the Rotodyne

will reduce more sharply than that of the helicopter because of the difference in performance.

There is considerable technical interest in the Fairey design on both sides of the Atlantic. British European Airways has studied its performance and has shown positive interest in it. BEA's present and immediate future equipment commitments have forced a "wait-and-see" attitude.

## U. S. Potential

In the United States, New York Airways sees the Rotodyne as one near-ideal answer to the problem of providing service to the middle of the metropolitan area without offending the sensitive ears of its residents.

The International Air Transport Association recommendations for a helicopter transport are met or exceeded in every category by the Rotodyne. Both call for 40 to 50 passengers. IATA asks for operating costs of five cents per mile and Fairey quotes three cents. IATA wants a 150 mph. cruise speed and the Rotodyne should make 170 mph. The IATA range of 200 mi. is more than doubled with the Rotodyne's 430 mi. And the vertical rate of climb at maximum power is 1,670 fpm. for the Rotodyne against the recommended figure of 600 fpm.

Fairey has calculated a weight breakdown for a conventional helicopter and for the Rotodyne. Comparisons are generally odious, but Fairey has had enough experience in both types of aircraft to make some reasonable estimates. It further put everything into percentages of gross weight, so that some uncertainties are omitted.

This comparison shows the Rotodyne structure weighs 17.9% against a helicopter's 21%. The powerplant and rotor drive is 18.8% of the Rotodyne, and 29.3% of the helicopter. Rotor weights are close at 13.9% for the Rotodyne and 12.1% for the helicopter; equipment is also close at 10% on the Fairey and 9.6% on the helicopter.

The result of the breakdown is that the conventional helicopter has available 28% of its gross weight for payload, but the Rotodyne is shown to have 39.4% useful load.

## Rotodyne Description

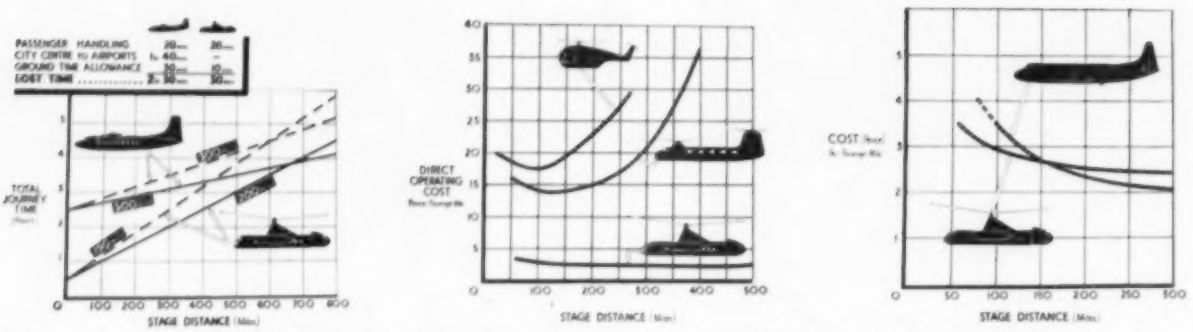
Aerodynamically the Rotodyne combines some of the principles of an autogyro, a helicopter and a fixed-wing aircraft in its layout. It is designed around a unique lifting and propulsion system which utilizes a jet-driven rotor, a fixed wing and twin Napier Eland turboprops driving auxiliary air compressors as well as conventional propellers.

The entire lifting and propulsion system is an integral unit mounted on top of the boxy fuselage. If future re-

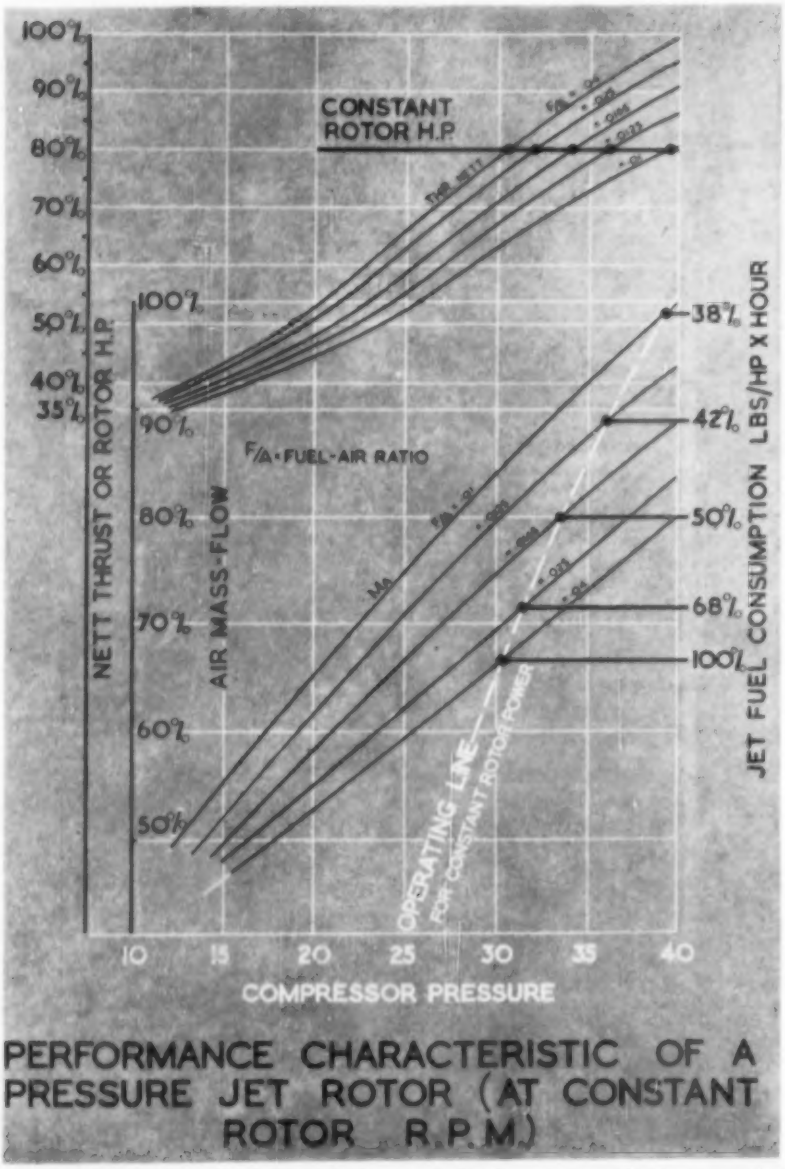
**CANTED** upper section of vertical stabilizer on Rotodyne was removed before flight testing.

**FAIREY'S** blade whirl test stand at Boscombe Down tests Rotodyne's powerplant and rotor.

**DOORS** at Rotodyne's rear open into 8-ft. wide, 6-ft. high, 46-ft. long compartment.




**TOTAL** time on a trip compares Rotodyne with conventional airplane (left). Lower costs are claimed for Rotodyne in comparison to contemporary single and twin-rotor helicopters (center). Viscount and Rotodyne cost comparisons show a crossover point at ranges of about 150 mi. (right).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OPERATING LINE FOR CONSTANT ROTOR POWER
COMPRESSOR PRESSURE
PERFORMANCE CHARACTERISTIC OF A PRESSURE JET ROTOR (AT CONSTANT ROTOR R.P.M.)

**PERFORMANCE** of the Fairey pressure-jet systems of helicopter propulsion is compared in the chart. The tip jets on the Rotodyne are Fairey developments that have been tried extensively in flight with the Jet Gyrodyne and on the ground in a number of test installations.

quirements should specify a completely new fuselage or other kind of storage and carrying container, the Rotodyne could be easily adapted to the new design.

The fixed wing of the Rotodyne is rectangular, with constant chord. It is mounted on top of the fuselage near the geometric center. The Twin Elands are carried outboard on the wing at about the mid-span. Conventional rectangular tail surfaces complete the fixed-wing portion of the Rotodyne geometry.

Also mounted near the geometric center is a four-bladed, 90-ft. diameter rotor, driven by four Fairey pressure jets at the tips. This rotor can be powered to give lift as a helicopter, or allowed to autorotate in a partially unloaded condition as an autogyro.

### Rotor Power

The rotor is driven by air pumped from the auxiliary compressors by the Elands. Each compressor feeds one opposing pair of blades through a complex rotor head; in the event of a single-engine failure, the remaining engine continues to supply power to half the rotor.

For vertical takeoff and landing, the fuel is injected into the pressure jets and burned to give the maximum rotor horsepower. During this flight regime, the propellers on the Elands operate at zero-thrust positions.

Transition to horizontal flight is done by increasing the propeller blade pitch so that the airplane begins to move forward. As it moves, the fixed wing begins to assume more and more of the total weight of the Rotodyne as lift, and the rotor can be unloaded. This is done by cutting off the air supply and the fuel, and the rotor goes into the autorotative phase.

Should an engine fail in hovering flight, the Rotodyne can continue to hover at normal gross weight on the remaining engine power driving half the rotor. If the failure occurs in cruising flight, the Rotodyne can climb at

200 fpm. at normal gross weight on one engine.

The Fairey development is hard to classify because at various times during its normal operations it is a helicopter and at other times it is not quite an autogyro and almost an airplane. It isn't a convertiplane in the usual accepted sense; there is nothing to convert except the aerodynamic loads which shift from rotor to wings.

This difficulty showed first in the design criteria for the Rotodyne. Since it was obviously no single type of aircraft, it had to be designed to match all the thinkable conditions of all the possible flight regimes.

### Planning Difficult

So the Fairey design team under Dr. George S. Hislop planned the Rotodyne to meet British airworthiness requirements for helicopters and for a comparable fixed-wing aircraft. Invariably there were conditions where neither of these criteria could apply, and that took considerable originality to overcome.

Single-engine performance, for example, was calculated to exceed current IATA requirements for helicopters by a substantial margin. This performance also meets fixed-wing engine-out requirements. The Rotodyne does this at its normal gross weight of 39,000 lb. on hot days up to ISA-plus-15C temperatures.

The rotor furnishes the control of the Rotodyne in pitch and roll; for yaw, differential propeller pitch is used up to transition speed around 80 kt., then conventional rudders take over.

Both collective and cyclic pitch changes are fed to the rotor from a hydraulic control system actuated by the familiar two-stick system of the helicopter. The pilot's left hand operates the collective pitch lever which also mounts a swivel throttle grip on the top. His right hand operates the cyclic pitch.

### Elevator Control

There are elevators on the Rotodyne but they are essentially only trimmers and are operated electrically, actuated by a switch on the cyclic-pitch stick.

Even if both engines should fail and there is no power transmitted to the rotors, the control system can still be used because the autorotating rotor drives its own emergency hydraulic system.

Differential pitch control is fed to the propellers through the pilot's foot pedals by way of a mechanical linkage on the clutch control of the auxiliary compressors. Reserve power for control in yaw has to be available when the compressors are clutched in; the exact balance of the linkage and the control system will have to be determined during the flight test periods.

The company says that stability and control in forward flight are comparable to any fixed-wing aircraft. For this reason they are confident that the Rotodyne will be an all-weather airplane with advantages that no fixed-wing conventional craft could have in slowness of approach and letdown.

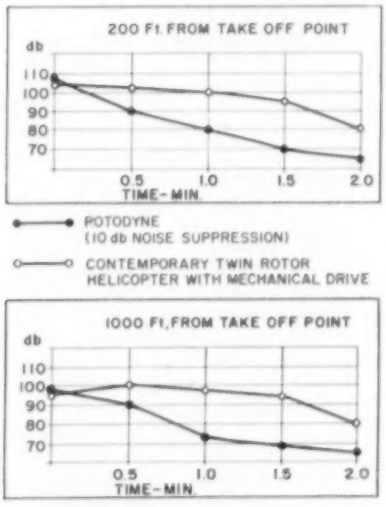
### Pressure-Jet System

The tip jets on the Rotodyne are a Fairey development that have been tried extensively in flight with the Jet Gyrodyne and on the ground in a number of test installations.

In rotor tip burners the designer has a choice of two general approaches. First, he can design a burner with radial combustion with respect to the rotor disc, so that only the exhaust products have to be turned through 90 deg. and exhausted. Or second, he can select tangential burning so that the inlet air to the burner has to be turned. The first system is used on the Fairey Ultra Light (AW Nov. 4, p. 107); the second on the Jet Gyrodyne and the Rotodyne.

Like other designs, the tangential burner is also a compromise. It is better than the radial type in case of manufacture and in its ability to take internal pressures and heat temperatures. But there is a pressure drop due to the turning, and the air entering is in an asymmetric pattern, making symmetrical combustion difficult.

Combustion chamber liners were developed empirically for the tangential burners of the Rotodyne. The overall design of the chambers has permitted




**NOISE COMPARISON** with conventional twin-rotor helicopter is shown to favor Rotodyne after takeoff. Black dots are for Rotodyne; white dots are for helicopter. Example: one minute after takeoff, Rotodyne noise is about 74 db. while helicopter is close to 100 db. 1,000 ft. from takeoff.

# PUMP PRIMERS

by
Arthur A. Nichols

***Multiple functions and separate fluid systems can be combined and serviced with maximum efficiency by a single Gerotor pump.***

Engine designers have recently been strongly attracted by Gerotor pumps which permit the incorporation of an extra pumping element in a separate chamber of the lubricating pump to provide fluid pressure for a control function or other use.

The unique construction of the Gerotor type pump permits aircraft systems designers to combine *several pumping functions* in a single pump housing mounted on a single pad and driven by a single shaft. Diversified systems such as lubrication, scavenging, low pressure hydraulic servo systems and motors up to pressures of about 1000 psi may be centralized in this manner. *(See fig. 1).*

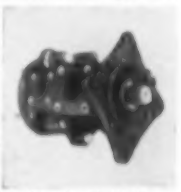


Fig. 1. Multiple function pump.

***The Gerotor pump*** is relatively simple. The moving elements are the toothed "Gerotors" — inner and outer. Both turn in the same direction and either one may be driven. The inner element always has one less tooth than the outer and the "missing tooth" provides a chamber to move the fluid from inlet to the discharge.

***Both Gerotor parts*** are mounted eccentric to each other encircling the shaft. This permits stacking a number of sets of Gerotors along the same shaft, in a common housing. By providing each set with a separate compartment and inlet and discharge ports, several fluid systems can be served simultaneously and without interference *(See Fig. 2)*. Different capacities can be provided for each system by varying the diameter or thickness of the Gerotor elements to vary the volume of the tooth chamber.

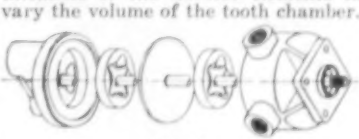


Fig. 2

***Advantages*** — The Gerotor is a positive displacement pump. It is simple and compact, lightweight, valveless, provides high volumetric and mechanical efficiency.

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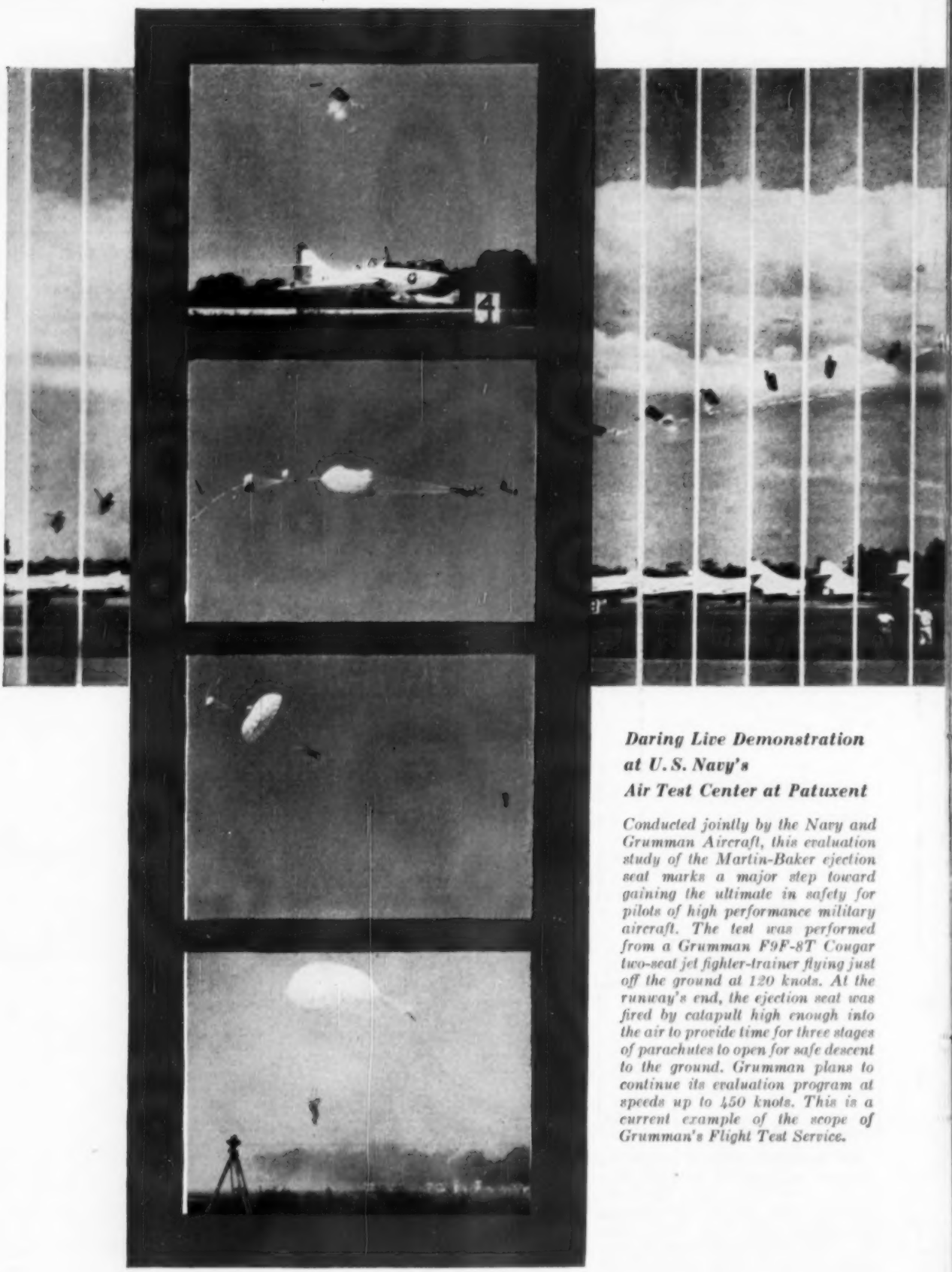
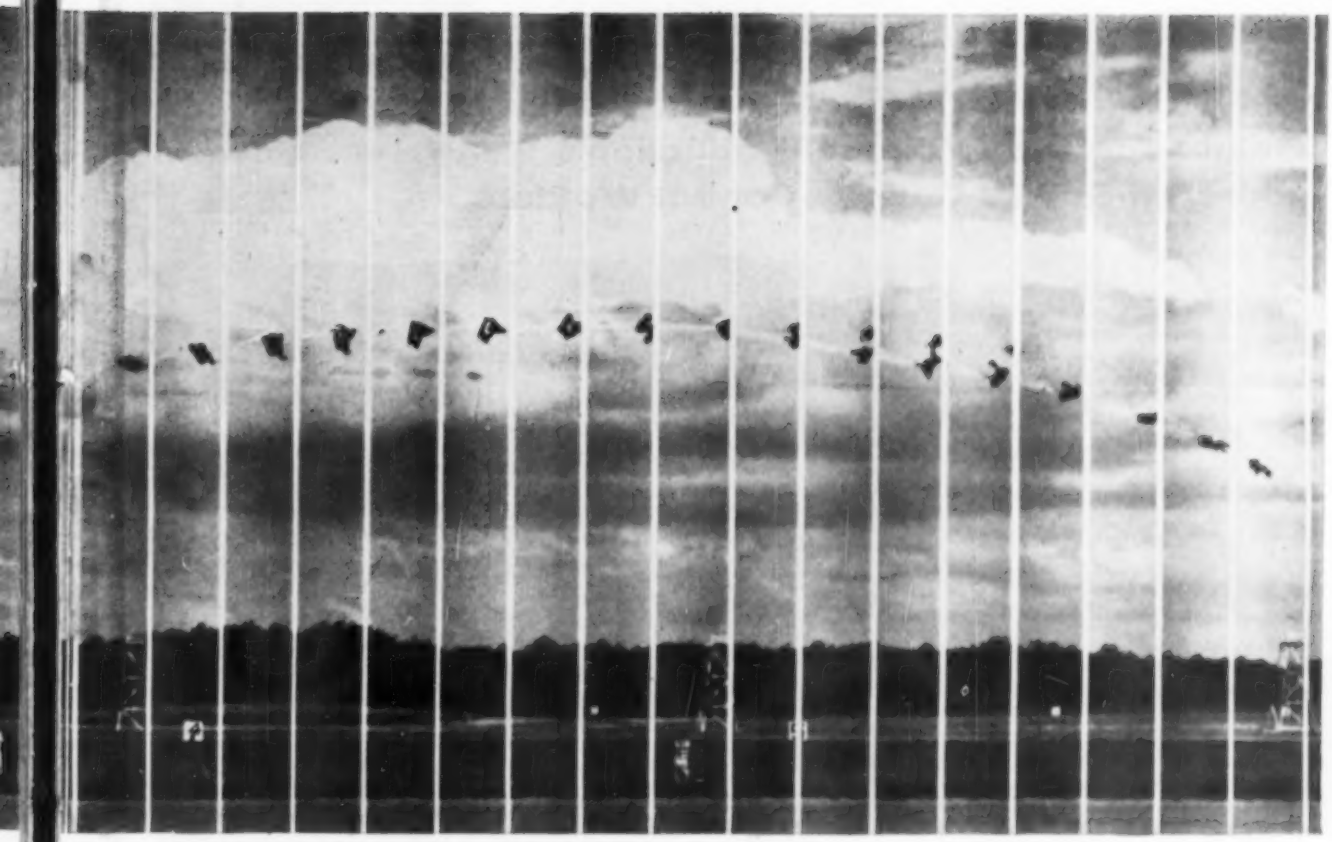


***Daring Live Demonstration at U. S. Navy's Air Test Center at Patuxent***

*Conducted jointly by the Navy and Grumman Aircraft, this evaluation study of the Martin-Baker ejection seat marks a major step toward gaining the ultimate in safety for pilots of high performance military aircraft. The test was performed from a Grumman F9F-8T Cougar two-seat jet fighter-trainer flying just off the ground at 120 knots. At the runway's end, the ejection seat was fired by catapult high enough into the air to provide time for three stages of parachutes to open for safe descent to the ground. Grumman plans to continue its evaluation program at speeds up to 450 knots. This is a current example of the scope of Grumman's Flight Test Service.*



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HELPS PUT PROFIT INTO MANUFACTURING

# Heintz Achieves Volume Production with New Sciaky Counter Control Welders

In fabricating and job shops, where a wide variety of assemblies must be welded to rigid specifications every day, Sciaky resistance welding helps keep production schedules *on schedule*.

The Jet Engine Division of the Heintz Division, Kelsey-Hayes Company, a large Philadelphia contract fabricator, manufactures original and replacement parts for the aircraft industry. This means their production must meet exacting jet engine specifications.

### New Sciaky Counter Control

To help meet these requirements, Heintz now uses Sciaky Patented Three-Phase Resistance Welders with the new Predetermined Electronic Counter Control. This new unit provides precise control of all welder functions for absolute production consistency. All control settings are realized with extreme accuracy, and are readily reproduced at any time to duplicate previous production runs. The machine cannot deviate from its setting.

**Fig. 1 Seam welding Nimonic to Nimonic on Pratt & Whitney Aircraft J-57 afterburner diffuser section.**

**Fig. 2 Seam welding stainless to stainless on Pratt & Whitney Aircraft J-57 jet engine transition duct assembly. Note simple fixture used.**

The Sciaky Predetermined Electronic Counter Weld Control is the only control of this type that has been proved in service, and the first unit of this kind has now been in use nearly two years.

### How It Works

The Sciaky Predetermined Electronic Counter Control counts the cycles of power line frequency which is governed by the U.S. Naval Observatory. In predetermined absolute numbers, cycles and impulses are simply counted by a Dekatron tube to control the duration of the various welder functions. The absolute consistency of the control eliminates the need for time-consuming periodical check-out or calibration. Plug-in feature permits easy unit replacement, or addition of other control functions if required.

### Operations Performed

Photos show typical Sciaky resistance welding applications on jet engine parts—Afterburners, Screech Screens, Engine Duct Assemblies, etc. Materials welded include Nickel Alloy, Nimonic and Stainless Steel.

### Information Available

Case histories outlining the successful use of Sciaky Resistance Welding Techniques on jet engine components are available on request. Specific recommendations will be furnished on receipt of an outline of your requirements.

**Write today, mentioning the information you would like to receive. There is no obligation. Sciaky Bros., Inc., 4935 W. 67th St., Chicago 38, Ill. POrtsmouth 7-5600.** 62-C

**CHART** shows a typical load which Rotodyne might carry in an area it could serve well.

the use of automobile-grades of gasoline, kerosene and aviation gasoline.

The Elands drive auxiliary compressors through clutches. Air passes from the compressors through a regulating valve to the rotor head and then into the three circular ducts inside the rotor blade. Flowing radially outward, the air enters the combustion chambers.

Fuel for the system is pumped from the wing tanks by a low-pressure pump through a regulator, which matches the fuel flow to the air mass flow, and to the rotor head. In the head the fuel is distributed at low pressure to the blade fuel lines. The centrifugal force of the turning rotor builds up fuel pressure to about 1,000 psi. at the tip, where it enters the combustion chamber through fuel spray nozzles.

Power regulation is simply a matter of throttling the air supply by the regulating valve. This valve is operated by the collective pitch lever which has an override control of the twist-grip type on top.

### Noise Reduction

Fairey began work on noise suppression about five years ago and reached the same conclusions everybody else had: noise is reduced when the relative velocity between the jet and the ambient air is reduced.

The way to decrease local velocities is to ease the jet out into the ambient air along a large periphery rather than through a minimum-area orifice.

Thus any nozzle with a shape anything but a circle will in theory produce less noise. In practice it will also produce less thrust and the job of the engineer is to find the nice balance where thrust is not reduced very much but noise is. There are also problems of drag and weight.

Fairey built and tested several dozen


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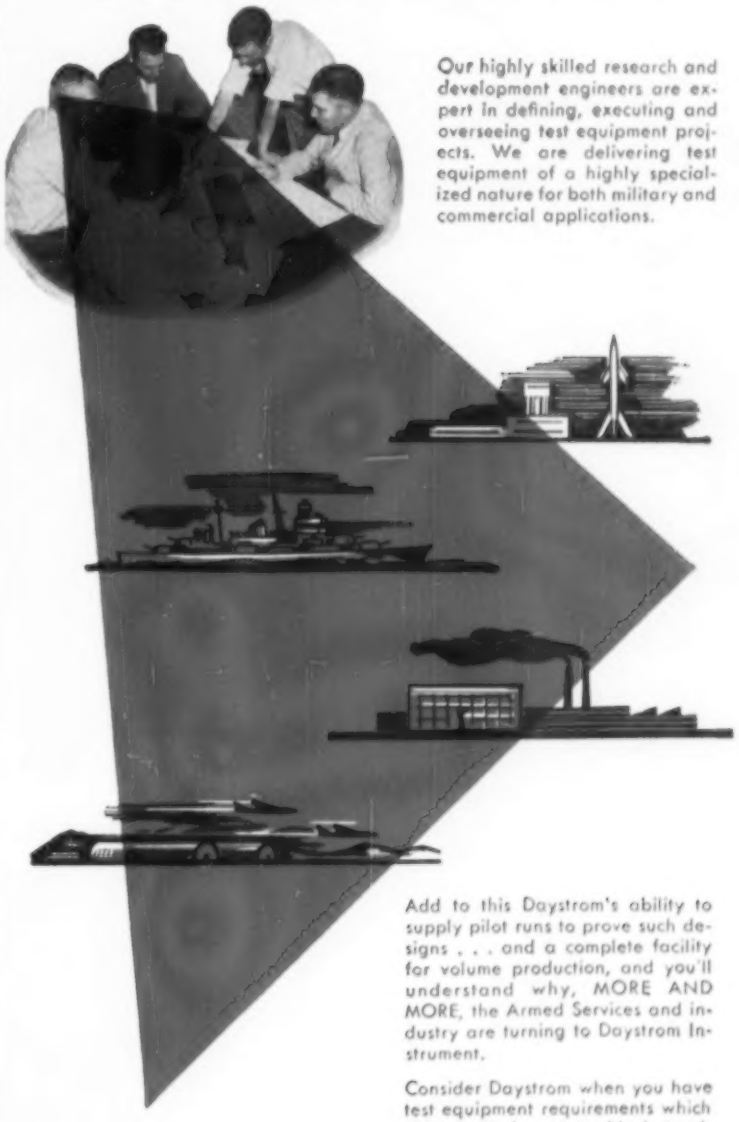

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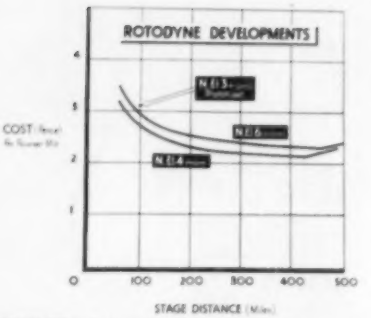
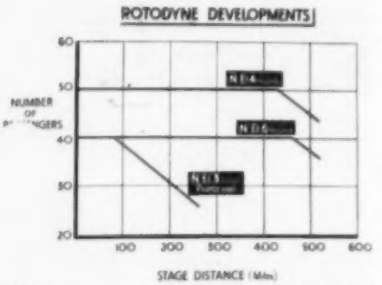



**HOW** Eland 4 and 6 improve performance.




**COST** curves of prototype, development models show reduction of 10%. Breaks at right are cutoff points on capacity range curves.

types of exhaust nozzles to get experience and some indication of the right track for development. Right now it has a noise suppressor which it has proved will drop the Rotodyne racket down to that of a current twin-rotor helicopter. Actual noise level has been dropped from somewhere around 105 db. to about 95 db., comparable to the noise in a subway station.

Noise contour plots made for the Rotodyne have shown that at takeoff, the level is about the same for both the Fairey aircraft and twin-rotor helicopters. But as soon as the Rotodyne is off the ground and flying, its superior performance reduces the noise level faster than in the case of the helicopter.

### Development History

The Rotodyne principle is 10 years old at Fairey, because it was in 1947 that the company started work on development of pressure-jet drives. The aircraft project was a 2,000 lb. helicopter with a propeller for forward flight, and the combustion chamber, with a thrust of 75 lb., was completely developed and tested.

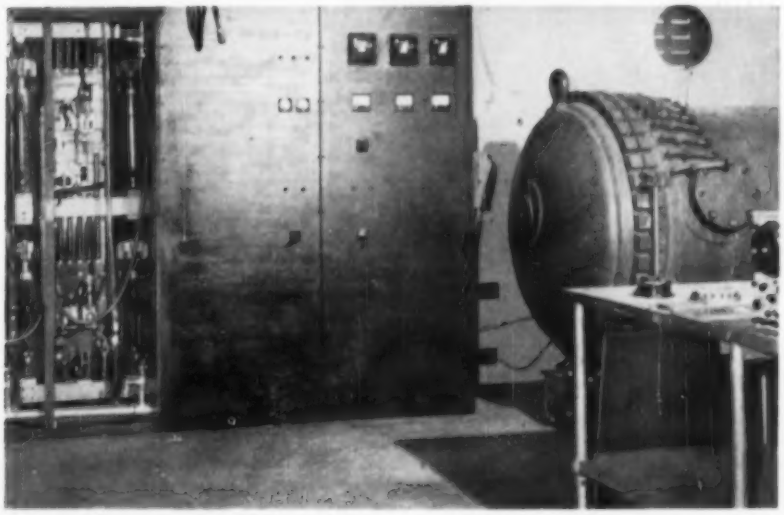
But within three years it became obvious that the real future for such a propulsion scheme lay in its application to large rotors. The 2,000-lb. helicopter went out the window, and a large transport type came in the door.

Development of the Jet Gyrodyne was initiated to get some background of experience with tip-jet propulsion

and the touchy problems of transition from hovering to forward flight. This work kicked off the acquisition of new test facilities at the company's airfield at White Waltham. By the end of 1953 the combustion chambers for the Jet Gyrodyne were completed and the plane flew in January 1954.

While this was going on, British European Airways revised its specifications for a transport helicopter. BEA asked for 40 seats instead of the former number of 25, and meant a redesign of the Rotodyne. The original appearance of the Rotodyne was basically like its configuration today except in detail (AW Oct. 6, 1952, p. 17). It had a five-bladed rotor of 80-ft. diameter and a pair of gas turbines driving auxiliary compressors. Fixed wings were to be used to unload the rotor in level flight and the whole idea was remarkably similar to the machine now flying.

Completely new test houses and apparatus were needed and built to cope with the extended scope of the Rotodyne program. Today the jet drive facilities at Fairey are large in capacity and versatile in scope. They include tethering sites and spinning rigs for the Rotodyne and the Ultra Light, a noise-suppression test area, and combustion static test rigs for the Rotodyne and Ultra Light, using a Napier Eland and a Rolls-Royce Dart engine respectively for power supply and compressed air.

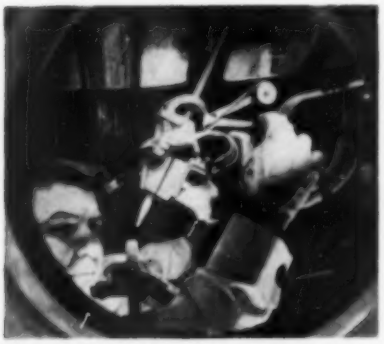


**HIGH** thermal flux test facility's control panel is at left; 150 psi. pressure vessel at right.

# Facility Studies Re-Entry Effects

**San Antonio**—High temperature research facility has been developed here by Southwest Research Institute under sponsorship of National Advisory Committee for Aeronautics.

High thermal flux testing facility now operating at Southwest Research Institute has reached average temperatures above 7,700F, and it is believed the new facility can go as high as 9,000F.

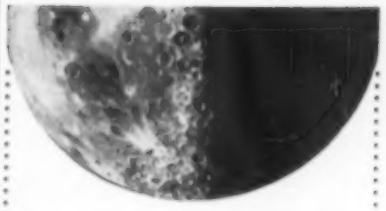


**CARBON** electrodes in pressure vessel are adjusted. Tests employ high intensity arc.

Facility will be used to test the effects of high energy concentrations of heat and light on chemical and physical properties of materials, and can be used for research on problems for re-entry into the atmosphere involved in U.S. ballistic missile programs.

NACA installation has a high intensity arc using carbon electrodes. It operates in air without the need for water stabilization, reducing possibility of such outside factors as water vapor influencing results. Unit is encased in a pressure vessel capable of handling pressures up to 150 psi.

System of parabolic mirrors directs energy from the arc to the test specimen. Specimen is held in a specially designed holder which permits control of pressure and gas composition. Thus,

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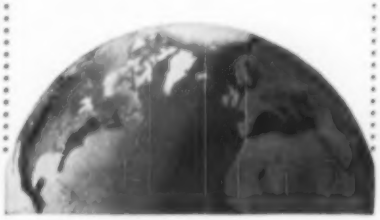

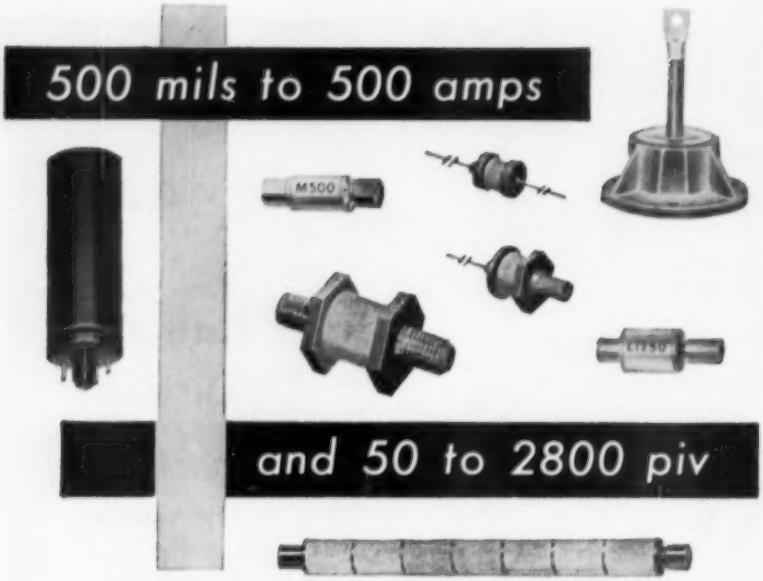


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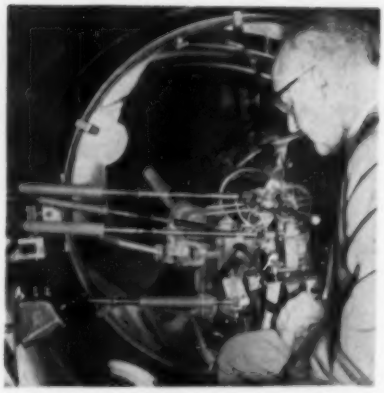


**SYSTEM** of parabolic mirrors (one visible at rear) directs energy from arc to specimen.

conditions met by a ballistic missile on re-entry can be closely simulated.

Results of tests are photographed through a port at the end of the pressure vessel by a camera shooting at the rate of 4,000 frames per second. Temperature is computed through a thermocouple activated for only a fraction of a second to prevent melting. Specimens are examined by several methods, including electron microscope and X-ray diffraction.

## Hawker Cancels P.1121 For Lack of Interest

**London** – Hawker Siddeley has stopped development work on its P. 1121 supersonic strike aircraft and "cocooned" the incomplete fuselage.

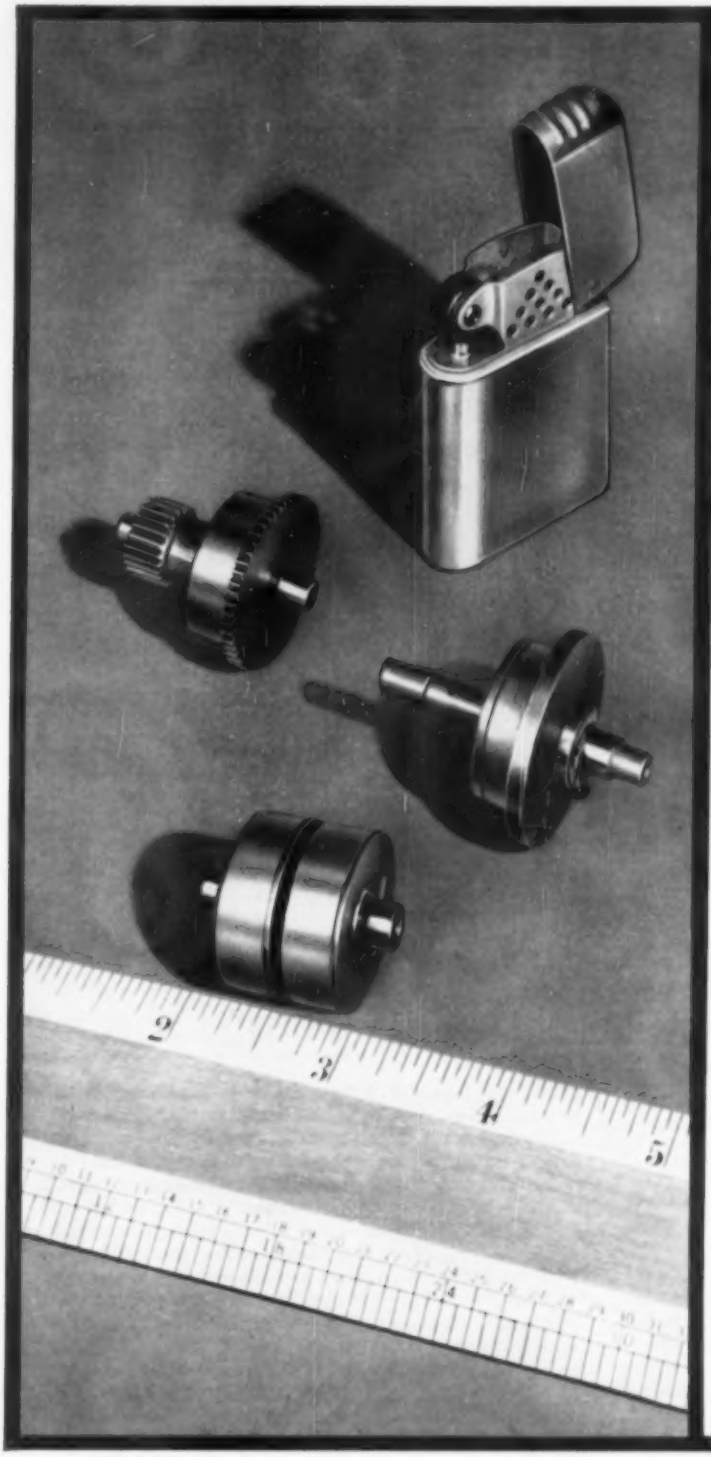
This was disclosed here at a conference in which officials also revealed that the group, which two years ago devoted 80% of its effort to aviation, now has shifted its emphasis so rapidly that only 30% of its current assets are in the aircraft field.

Sir Frank Spriggs, Hawker Siddeley managing director, said work had been stopped on the P. 1121, which the group was developing with its own money, because no customer had been found for it. The North Atlantic Treaty Organization showed some interest, he said, but nothing further has materialized.

Total assets of the Hawker Siddeley group, including its large Canadian interests, are $599.2 million, it was revealed for the first time. Total group turnover this year is at a rate of $729 million a year.

Spriggs emphasized that while the erstwhile aviation empire was expanding and broadening its base, there was no intention of abandoning the aviation field entirely.

Hawker Aircraft has enough orders for the Hunter fighter to keep its assembly line going for another four years in spite of the government cut-



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**Occasion:** the Eastern Joint Computer Conference in Washington.

**Event:** a major breakthrough of speed, quality, flexibility and cost reduction in the field of data processing and transfer.

**Featured:** the new device pictured above.

Known as the "Stromberg-Carlson Model 5000 High-Speed Electronic Printer," this equipment combines CHARACTRON® computer read-out tube, made by Stromberg-Carlson, and XEROX® COPYFLO® electronic printer, made by Haloid. Together, they translate stored electronic information into visual material —at 5 to 10 times the volume output of mechanical printers representing the same investment.

In operation, the CHARACTRON shaped-beam tube reads out and displays on its face the output of any data processing equipment—at speeds up to 10,000 characters a second. Acting electrostatically and with *dry* materials, these displays sensitize the surface of a selenium drum in the XEROX COPYFLO printer. The data are then transferred to a roll of paper, vellum or multilith master and come off the printing machine at the rate of 5,400 pages an hour!

Besides speed, many other advantages are inherent in the system. There is no intermediate processing, as with engraving or letterpress—*lower cost per page!* Manufacture of the "Model 5000" utilizes printed circuitry and transistors—*dependability!* Texts, graphs and business forms can be combined—*flexibility!* And computers whose idle time may be valued at as much as $300 an hour can be "emptied" in just minutes—*efficiency!*

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back of its Hunter orders, it was stated. In addition to the recent $65 million order from India, several other large foreign orders are "nearly in the bag," according to group director, Sir Roy Dobson, who also is managing director of Avro Canada.

Commenting on the new Avro Arrow, which he described as a 70,000-lb. aircraft capable of "something better than Mach 2," Dobson said it was expected to play a large role in North American defense, with considerable U. S. interest being shown. He said the Iroquois engine already is under consideration for several new U. S. aircraft.

Spriggs said no decision has yet been made in the British European Airways competition for a new turbojet airliner.

Hawker Siddeley has offered to develop this aircraft with its own money if awarded the contract, a task which Dobson estimated would cost between $48 and $56 million. He said the aircraft would be supplied to BEA at a price which did not include development costs. Bristol and de Havilland also are entrants in this competition but neither is prepared to undertake the contract without government backing. Nevertheless, the latter two firms are favored.

A. V. Roe has submitted a design study to the Ministry of Supply for a supersonic airliner but has not yet had and response, Spriggs said. It was revealed that Hawker Siddeley also is studying possible entry into the executive aircraft and helicopter fields.

## PRODUCTION BRIEFING

**Stratos Division** of Fairchild Engine and Airplane Corp., Bay Shore, N. Y., says it has formed an Advanced Products Planning Group, headed by Jerzy Makowski, former chief research engineer. This group will do preliminary design work on aircraft equipment based on predictions of what will be needed long before any prime contractors come up with specific needs.

**Utility Metal Products, Inc.**, Pasadena, Calif., and its subsidiary, Utility Aircraft and Metal Products, Ltd., Granby, Quebec, have been purchased by L. A. Young Spring & Wire Corp., Detroit, according to the latter firm. Utility has 900 employes and manufactures aircraft and missile structural parts. The firm is said to be skilled in honeycomb structures, molybdenum, inconel and hastelloy. Utility also operates the largest skin mill on the west coast for fabrication of aircraft wing and fuselage skins, according to Young. The mill is said to take pieces up to 23 ft. wide and 60 ft. long.

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|---|---|---|---|---|
| ACCURACY | 0.1% Full Scale | | | |
| RESOLUTION | Better than 0.001% | | | 0.0002% |
| LINEARITY | 0.1% | 0.05% | 0.1% | 0.05% |
| RANGES | ±0.1G to ±20.0G | | ±0.5G to ±10.0G | ±0.05G to ±50.0G |
| OUTPUT, MAX. | ±35 volts | ±15 volts | ±45 volts | ±8 volts |
| COMPANION POWER SUPPLY | Model 4051 $175.00 | Model 4071 $250.00 | Model 4071S $250.00 | |
| MAGNETIC SHIELDING | Yes | Yes | No | Yes |
| NET WEIGHT | 1.6 lbs. | 1.3 lbs. | 0.8 lbs. | 0.2 lbs. |
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**FIRESTREAK** installation on the English Electric P.1B confirms an earlier Aviation Week report (AW Sept. 16, p. 28) of missile locations on fuselage sides. Armament of the interceptor includes a pair of the de Havilland infrared homing missiles and twin Aden 30 mm. cannon.

# Firestreak Groomed for Operational Use

By David A. Anderton

**Hatfield, England** – De Havilland Firestreak infrared homing missile is about to enter full production for both Royal Air Force and Royal Navy.

The air-to-air missile has been standardized as armament for Navy's de Havilland Sea Vixen and RAF's English Electric P.1B and Gloster Javelin. It is the second air-to-air missile arming British aircraft. First was Fairey Fireflash, a beam-riding dart powered by two solid propellant rockets.

De Havilland is completing a new factory for Firestreak final assembly at Walkden in Lancashire and meantime has established missile engineering and production teams in operation here. They are working now to regain time lost during the engineering strike earlier this fall and to supply the large demand for live development test rounds for flight tests on current aircraft.

### Other Aircraft

Firestreak can also be matched to the North American Sabre series, de Havilland Venom and Sea Venom, Hawker Hunter and Saunders-Roe 53. Live rounds have been fired from the Australian-built Avon Sabres at the proving ground at Woomera, and from Venoms in England and from Canberras.

Entire responsibility for design, development and production of Firestreak has been given to de Havilland Propellers Ltd. under the British approach to the weapon system concept.

Firestreak (code-named Blue Jay in British missile nomenclature) is easily recognized by the unique shape of its nose, which consists of eight triangular optically flat pieces of heat-resistant glass.

Behind the head stretches a cylindrical body about eight inches in diameter. Four fixed trapezoidal wings of very low aspect ratio are mounted behind the geometric center of the body. Less than one wing chord length behind are four movable rectangular control surfaces of low aspect ratio.

### Boost-Glide

Powerplant is a single solid-propellant motor which discharges through a small duct section and nozzle. Duration of burning is short, so Firestreak can be considered to follow a boost-glide trajectory.

Overall length is 10 ft. 6 in. Wingspan is about 32 in. Wings and control surfaces are in the same planes, and are indexed at 45 deg. with respect to a horizontal plane through the thrust line of the missile when the Firestreaks are mounted on the parent airplane.

An integral part of the weapon is its launching rack, a 5 ft. assembly of anodized aluminum alloy. It carries a single attachment point similar to a bomb rack, plus two locating points which mate with corresponding sockets on a bomb rack, a wingtip location or an underwing pylon. Services for the Firestreak missile are built into the launcher rack, so that the entire assembly of rack plus missile is a self-contained unit which only has to be attached to the airplane and plugged electrically into the plane's power supply system.

Flexibility of the Firestreak installation was shown at the 1957 Society of British Aircraft Constructors display at Farnborough (AW Sept. 9, p. 26). Typical armament layouts included:

- **Single rounds** at both wingtips of the Saunders-Roe 53 mixed-powerplant interceptor. Plane was shown and flown with dummy rounds as were all others at Farnborough. Saunders-Roe says the plane and missile have been matched aerodynamically but no live rounds have been fired.
- **Four rounds** singly attached to individual short pylons under the wings of the Sea Vixen, one of the airplanes which the missile will arm.
- **Four rounds** attached under the wings of a Gloster Javelin in a similar installation but with longer pylons under the wings. Bullet fairings were added to

**UNUSUAL** position of de Havilland Firestreak missiles is shown in this view of the English Electric P.1B. Note the spiked intake with its central body, designed to force an inclined shock, and the sharp lip of the intake duct, which was designed to reduce drag.

the junction of the pylon and the wing leading edge to smooth the flow over that critical area.

- **Two single** rounds mounted on Pylons underneath the Hawker Hunter wings.
- **Two single** rounds mounted on stub horizontal pylons below the cockpit on a model of the English Electric P.1B.

No details were available on the cockpit installations and the necessary auxiliary equipment needed to make the missile usable on an aircraft. But the basic simplicity of the infrared homing system is that there is no need for airborne beamlaying radars.

The homing head is tied into the normal fire control radar supplied in the fighters which the missile arms. That radar is used in the conventional manner to pick up the target, but after acquisition the Firestreak homing head presumably looks on to the infrared source and stays locked through the firing and interception.

Since the system is completely active itself, the fighter can break away from the attack immediately after launching the missile.

With an eye on export sales of the weapon, de Havilland has stated that—to use one example—the effectiveness of the Sabre series can be improved even further by installation of the Firestreak. They say the missile can be fired from considerably below and behind a target. Useful range must be on the order of several miles; perhaps five miles would be a reasonable estimate.

Internally Firestreak consists of six major assemblies: guidance, control system, fusing-system, power supply, powerplant and warhead.

Aft of the "pencil-point" nose, the missile increases slightly in diameter to its maximum. This tapered section must contain all the guidance, control, fusing and power systems.

Control actuators are at the aft end of this tapered section, and transmit their motions to the control surfaces at the

**SIMULATED** P.1B, mocked up from components of the aircraft's fuselage, ventral tank and tail, receives the full blast of a de Havilland Firestreak during launching, with no ill effects. Tests, part of a program for the English Electric plane, record blast pressures and temperatures on the airframe during launching. Ventral tank is packaged rocket powerplant designed to increase P.1B's altitude performance.

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tail by means of cables. The cables run outside of the sustainer motor under the long rectangular fairings visible at the wing root attachment to the fuselage of the missile.

The sustainer rocket extends over the length covered by the cable fairings. None of the rounds shown at Farnborough had prototype nozzles or tail cones, but it has been reported that the rocket discharges through a circular section of ducting into a conventional nozzle.

The warhead charge most likely is wrapped around this section which is just ahead of the movable control surfaces. Such annular warheads in tail locations have been used on missiles in the U.S.

### Company Decision

De Havilland Propellers got into the missile business as a result of a company decision to do so. It felt its competence in avionic and hydraulic systems development work would be a useful background for the development of new weapons. In this respect its attitude was similar to that of Curtiss Propellers and Hamilton Standard in the United States, both of whom got into development of systems work not directly related to propellers but drawing on the experience gained in propeller design, development and manufacture.

Total number of technicians now working on the missile side of de Havilland Propellers is "several thousand," the company says.

First work in the new field started when de Havilland was asked by the Ministry of Supply to develop a turbo-alternator. Work on this unit was followed by a second contract for the development of an infrared homing head, following through the original work done by the Ministry's radar research establishment.

With both jobs almost completed, de Havilland got a development contract for a complete missile and in preliminary analysis of the requirements, decided to do all the design and manufacturing within the company.

This early progenitor of Firestreak used a booster rocket at launching, and it was natural that the first firing tests should be to check booster separation. The tests were made at the Royal Artillery Range at Larkhill in Southern England.

The program developed progressively, after proving the separation technique.

Performance of the turbo-alternator in flight was the next item to be checked and rounds with the unit installed were fired at Larkhill. All of these test rounds were short duration, limited by conditions of range safety. But before their brief flights were

**Snark Gets Boost**

**USAF's Northrup Snark SM-62 intercontinental missile begins 5,000-mi. flight over the South Atlantic Ocean after being launched from the Air Force Missile Test Center at Patrick AFB, Fla. Angle shows booster firing of Pratt & Whitney J57-powered missile.**


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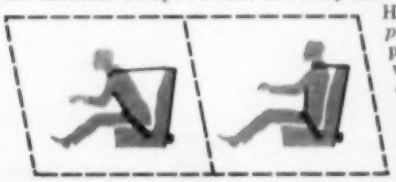

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*REPRESENTATIVES: Eastern U.S.–Aero Eng. Co.*

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stopped by intentional destruction of the missiles, they had transmitted back enough data to satisfy the de Havilland engineers that they were on the right track.

### Further Testing

Firings continued with missile components being added singly to successive rounds. The next group of tests included both power and control systems to check performance of the coupled units in their response to imposed signals. Final group of development tests checked the performance of the homing head while locked on a target. However, at this stage the head was not controlling the flight path of the missile but merely recording the target position. Instrumentation in the missile telemetered the data back to base.

First complete missile with operational homing and control systems was fired at night at Larkhill. The target was a large heated wire frame simulating infrared radiation from an airplane. It was several miles downrange. The Firestreak hit the frame.

While the ground tests were being made, early flight tests of a Venom with the final form of Firestreaks aboard were being done at the Ministry's missile range at Aberporth in Wales. First tests were to check jettisoning of the rounds from the Venom.

First live round fired as part of the airplane test program was launched from a static Venom parked near Aberporth and pointed down the range. Purpose of the test was to check blast effects on the adjacent airplane structure. There were no signs of damage or of marking of the plane.

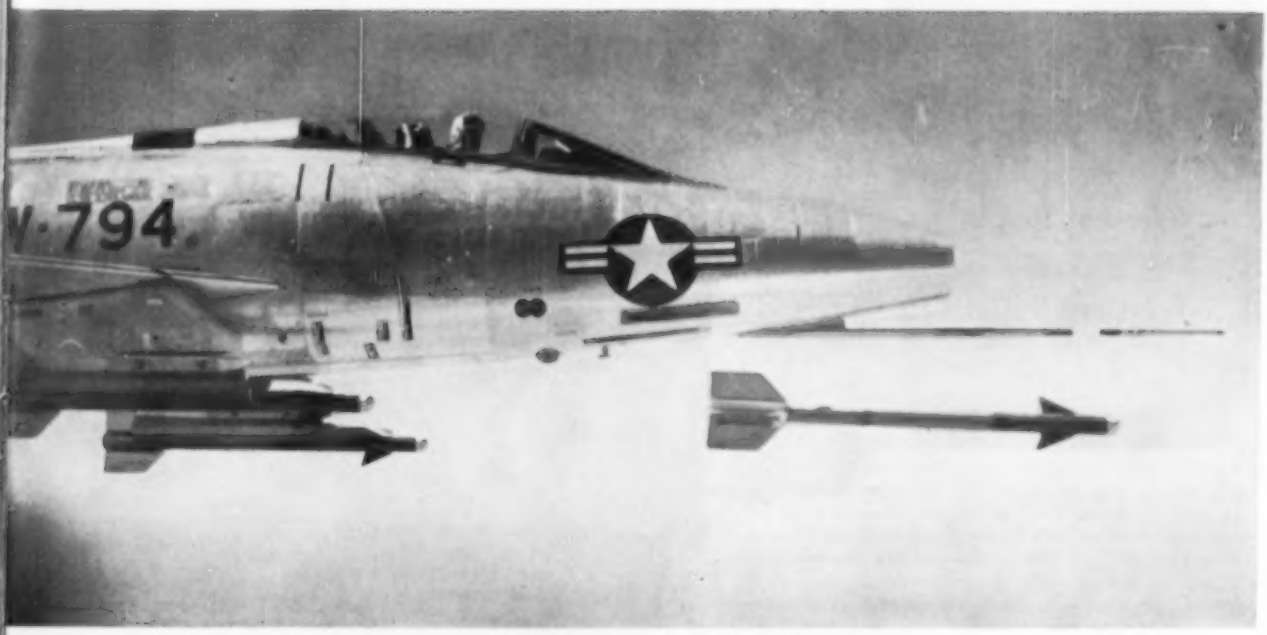
Next group of live rounds was fired from the Venom over the Aberporth range to check the aerodynamic performance of the Firestreak. Flight path data were telemetered routinely.

### Target Killed

First complete and operational Firestreak was fired from the Venom at a target airplane which had heaters installed to simulate the radiation from a contemporary jet airplane. This round also worked and the target aircraft, mortally wounded, splashed into the water.

De Havilland had unusual good luck with its test program in that each of the first rounds in critical phases of the tests worked the first time and worked properly. The first booster separations, the first prototype ground-launched missile and the first air-launched operational missile all functioned neatly. The effects of this happy performance streak on the morale of the engineering teams was outstanding.

Since the early stages of the Firestreak program, Aberporth has been



## Sidewinder on Its Own

**Sidewinder infrared-guided air-to-air missile is fired from a North American F-100's underwing rack during a firepower demonstration at Eglin AFB, Florida. The missile, produced by General Electric and Philco Corp., has an optional head (IRdome) (AW Oct. 28, p. 37).**

used for airborne tests of the missile. But its range limited the use of high-speed target drones and the overwater flights all but eliminated the possibility of recovering test rounds after impacting the target or receiving the bits of the target itself to determine the lethality of the warhead burst.

The enormous expanse of the missile range at Woomera in Australia was the next place to go and de Havilland arrived there early in 1955.

The Australian-built Avon-powered Sabre was the first test vehicle adapted to the Firestreak. Some internal installations were necessary. Firestreaks were pylon-mounted under the Sabre's swept wings and a camera plus instrumentation pod was installed as a blister on the Sabre's belly under the cockpit.

### Australian Firings

After aerodynamic matching and other initial trails, the firings began, using Jindivik jet-powered drones capable of speeds on the order of Mach 0.8. Since then, continued work has increased the kill probability of the missiles, so that today the Firestreak stands as a useful and usable air-to-air weapon.

The only complaints voiced about the program have been that production of rounds for flight tests on other aircraft has not kept pace with the demand. At least one British aircraft manufacturer has had a weapons development program held up by lack of hot rounds for firing tests.

But de Havilland is taking steps to lick this bottleneck. The new factory at Walkden is one outward indication. So are the ranks of new machines and equipment dotting the floor of the company's factories here and at Bolton in Lancashire.

Technical service staffs, built up by the company to handle instruction and field problems, are currently putting the first classes of Royal Air Force personnel through training and instruction on Firestreak.

Best estimates of the operational availability of the missile see it in squadron use with Gloster Javelins before the end of 1958. By that time as Sea Vixens and P. 1Bs enter squadron formations, the production flow should be sufficient to arm them with the Firestreaks right from the start.

## High Starting Torque In Missile Actuator

Actuator motor for missile use is basically a rotary solenoid with vibrating rate of 120 cps. when operated on 60 cycle a.c., vibratory motion being translated into rotary stepping motion through a fast-acting one-way clutch. Inherently the device is moderate speed and at either 60 or 400 cycles will operate at free speeds of less than 300 rpm. Units are available delivering up to 10 in./lb. at 15 rpm.

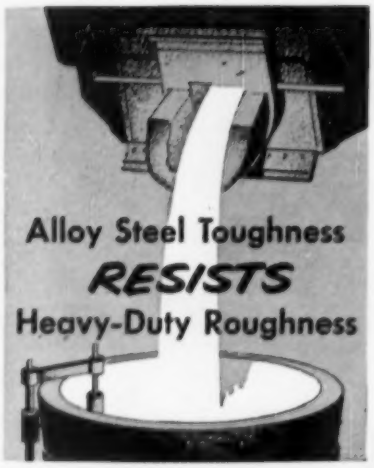
Starting torque is stated to be equal to running torque and unit stops within 10 milliseconds at 60-cycle operation and five milliseconds at 400 cycle operation. Manufacturer is Viking Tool & Machine Corp., 20 Main St., Belleville 9, N. J.

## Accelerometer Free Of Natural Resonance

Self-generating dynamic accelerometer capable of handling accelerations to 1,000Gs is designed to missile and aircraft applications where high-frequency transients or step-function inputs are expected. Type 4-420 accelerometer operates over a frequency range of 3 cps. to 60 k.c., has a flat response of ±6% between 5 cps. and 40 k.c. Accelerations of 5,000Gs will not harm the unit, the maker states.

An electrokinetic principle—forcing the polar liquid through a porous substance to create an electrical potential across the substance—makes the unit free from any natural resonances and therefore aperiodic in nature, the firm reports.

Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Calif.



Landing-gear strut for the North American F-100C is manufactured by Bendix Products Division, Bendix Aviation Corporation. Exacting requirements for inner and outer cylinders resulted in the development of a new grade of steel by Bendix and Republic metallurgists working in cooperation with North American engineers.

## How Metallurgical Teamwork Developed the Super Sabre's Tough,

When a new grade of steel is born, there's sure to be an interesting story behind it.

In this case, it's the story of close cooperation between metallurgical teams from Bendix and Republic. Their common goal: development of a tough, strong, alloy steel to withstand the shock, impact, strain and vibration of tons of aircraft hitting the runway at speeds in excess of 100 miles per hour.

It starts after World War II, when Bendix metallurgists undertook a program to correct certain characteristics and improve processing deficiencies of steels commonly used for aircraft landing gear.

Several leading steel companies, including Republic, were consulted and the program outlined. Republic immediately put its 3-Dimension Metallurgical Service Team on the problem.

The field metallurgist worked closely with Bendix metallurgists and engineers right in their own plant under actual operating conditions. Their findings were supplemented and coordinated by the other two members of the Republic team—the laboratory and mill metallurgists.

The result: development of a new grade of steel that

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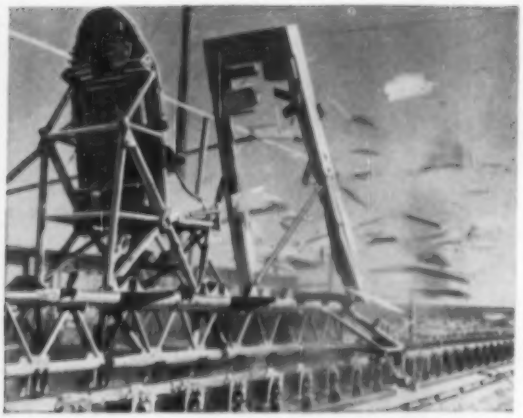

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Convair's F-102A—an advanced supersonic fighter for the Air Force

# Bring your tough ones to Zenith

The sleek nose cone of Convair's F-102A supersonic fighter is a Zenith-built radome. It had to be built to serve as a structural part of the airplane—strong enough to punch its way through the turbulence of supersonic flight...tough enough to stand the blistering temperatures. But it also had to be made with all the delicate precision devoted to a fine camera lens, because its real purpose is to admit radar beams without distorting them.

To combine all these qualities, Zenith developed a solid-wall preform laminate structure. It required an extremely close-tolerance balance between resin and glass fiber contents to give it a correct dielectric constant, optimum transmission, and minimum boresight shift.

Not an easy job, but we welcomed it. Through challenges like this, we've learned to form resin-bonded glass fiber for almost every electronic and structural purpose, in almost every shape and size—and to produce it by modern production-line methods. We can usually simplify the design and tooling required for equivalent metal parts.

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FORM OF THE FUTURE: RESIN-BONDED GLASS FIBER

# Smaller C-130 Propeller Reduces Noise

By George L. Christian

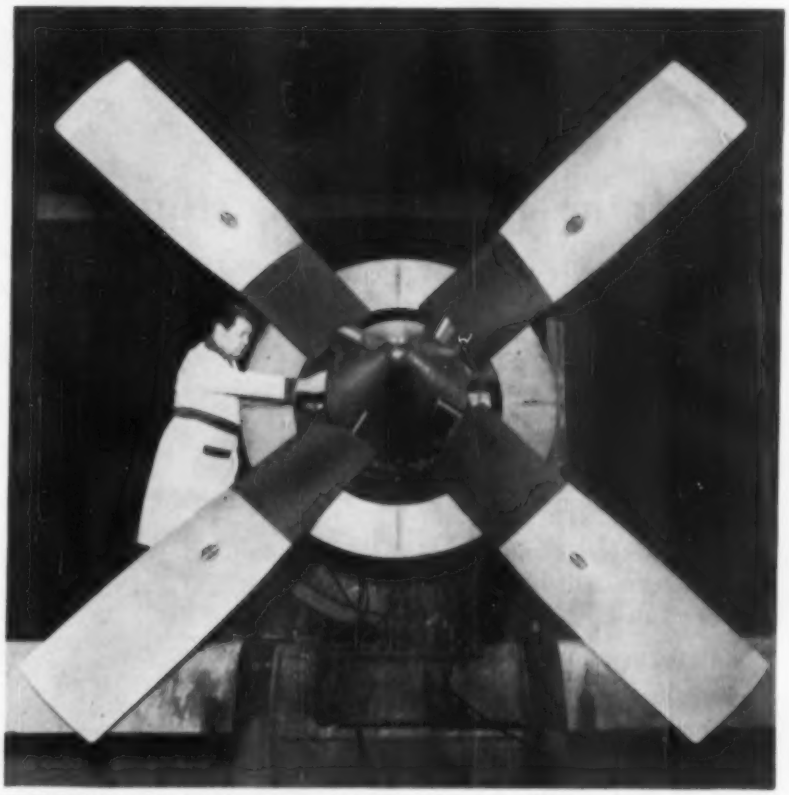
**Windsor Locks, Conn.**—Use of Hamilton Standard propellers on Lockheed's advanced version of the C-130 Hercules is expected to reduce noise level.

First C-130s were equipped with Curtiss Electric propellers. Before many planes were built, Air Force decided to switch to Aeroproducts units and took a delivery delay of C-130s to allow Lockheed to make the retrofit change.

Production models of the C-130A are fitted with Aeroproducts propellers. Award of the contract to Hamilton Standard for the C-130Bs was the result of negotiated procurement in which all three propeller manufacturing companies submitted proposals.

Air Force officials told AVIATION WEEK that the reason for selecting Hamilton Standard propellers for the C-130B was that the company met all technical qualifications and was low bidder. Total contract is for approximately $9 million.

Lockheed said that Aeroproducts propellers on the many C-130s now flying are giving excellent service.



**HAMILTON Standard hydromatic propeller for Hercules C-130B turboprop transport is adjusted by technician in test cell prior to endurance tests. Propeller is 13½ ft. in diameter.**

### Turbine Prop Development

In the past 10 years Hamilton Standard has spent $28,500,000 on propeller development directly associated with turbine engine applications. The developments covered a variety of propellers for such engines as the General Electric T31, Pratt & Whitney Aircraft T34 and T57, Allison T54 and T56 and Lycoming T53.

Over 11,000 hr. of actual test experience have been accumulated on these turboprop engines on static ground test stands. Flight time for such propellers now amounts to approximately 12,000 hr. Most of this flight time was accumulated with the A3470 propeller on Pratt & Whitney's T34 in the Lockheed C-121F airplane flown under recent MATS accelerated test program.

Based on this experience, that of its licensee, de Havilland of England, and on millions of hours of service of its hydromatic propellers in military and commercial service, Hamilton Standard has tailored the 54H60 propeller to the Allison T56 engine and the Lockheed C-130B airplane.

New Hamilton Standard propeller "incorporates safety and performance features which make it the most advanced of our line of hydraulically-operated propellers for reciprocating and gas turbine engines," according to the manufacturer. Props are mounted on the plane's four Allison T56 turbine engines, each of which develops 4,050 hp.

### Lower Noise Level

Propeller has been under accelerated development at Hamilton Standard for the past two years. It is a four-bladed unit 13½ ft. in diameter (currently used Aeroproducts propellers are three-bladed and have a 15 ft. 1 in. diameter). Blades are solid aluminum alloy. Reason for going to a smaller diameter, four-bladed prop is to reduce noise level.

Independent source with its own pumping system is provided for pitch changing which includes reverse pitch.

Pumping system incorporates two propeller-driven pumps for operating of the pitch change motor. Pumps are arranged so that one operates continuously to provide the capacity for normal propeller changes. Second pump bypasses its output to drain except when large pitch change rates are required. At such times the second pump adds its output to the first to provide a pitch change rate of more than 20 deg. per second to prevent turbine overspeed or compressor stall.

Barrel of the new hydromatic is stronger, yet lighter, than conventional hydromatics due to the incorporation of a spider into the back half of the propeller's barrel. This change over the conventional split barrel design gives greater strength to the rear half of the barrel and results in an overall decrease in barrel weight.

### Automatic Pitch Lock

Another new development is an automatic mechanical pitch lock which can be set to operate at any chosen percentage of turbine overspeed. When activated by an overspeed it locks the blades in their existing position to prevent further reduction in blade angle toward low pitch and holds drag to a minimum.

Propeller's electrical functions in-

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T-J CLINCHORS set clinch nuts with fully automatic operation, controlled by a single foot pedal. Available in Underfeed and Gravity feed models, throat depths 8" to 36".

Send today for these helpful references: Rivitor bulletins 646 and 555 . . . Clinchor bulletin 555. The Tomkins-Johnson Co., Jackson, Mich.

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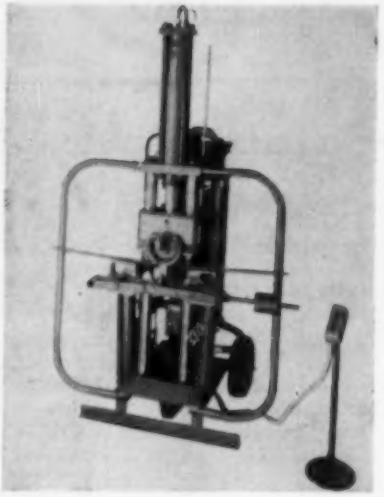
**T-J CLINCHOR** adaptable to a wide range of clinch nut setting problems. Gravity feed model shown here.

## Small Bending Machine

Wallace No. 1402 Vertical Ram Type Bender is portable and small—occupies 100 in. x 45 in. floor space. Machine can bend 2-in. heavy steel pipe through 180 deg. without repositioning dies or relocating item being bent. It can handle shapes such as coils, return bends, special curves, angle irons, channels and flat bars. Bender incorporates a duplicator which will allow the machine to make an unlimited number of identical bends. Push button control actuates hydraulically-driven ram to perform the bending. Address: Wallace Supplies Mfg. Co., 1304 Diversey Parkway, Chicago 14, Ill.

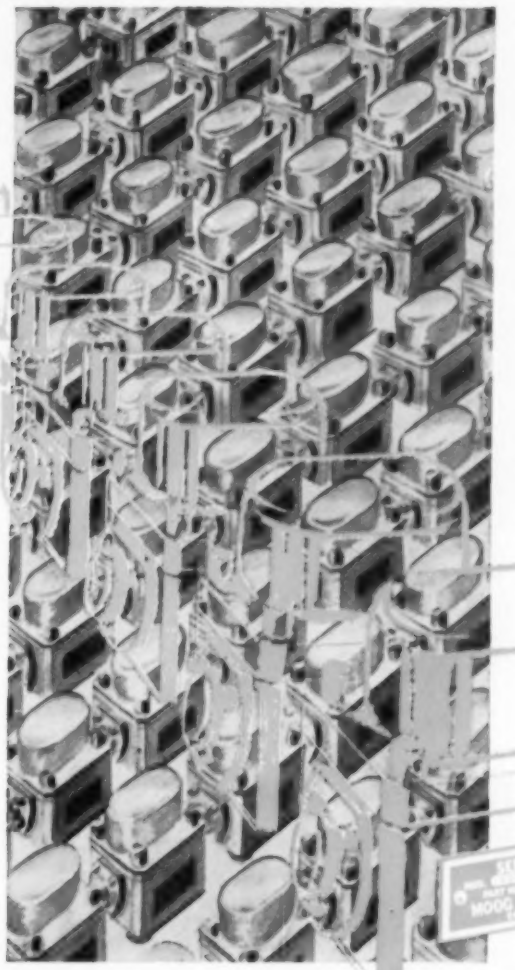
clude an electronic trimmer for greater governor stability, electrical de-icing for the blades and spinner, and electronic synchrophasing for synchronization of blade angle.

### Safety Provisions

Among provisions for propeller safety are a means for either feathering the propeller or holding it at close to the feathered position. Normal feathering is provided by a condition lever which operates a valve directing full pump output to high pitch and bypassing the normal governor control. In addition, if the propeller tends to drive the engine, an automatic negative torque signal is activated which moves the propeller back toward the feathered position and continues to operate until the negative torque condition is eliminated or normal feathering action is taken.

Hamilton Standard says that the 54H60 has satisfactorily completed compatibility and limited endurance tests on the Allison turboprop engine at Allison's plant in Indianapolis and at Hamilton Standard's facilities at Windsor Locks, Conn.

Deliveries on the new propeller will begin next June. The C-130B will be manufactured at Lockheed's Marietta, Ga., plant.



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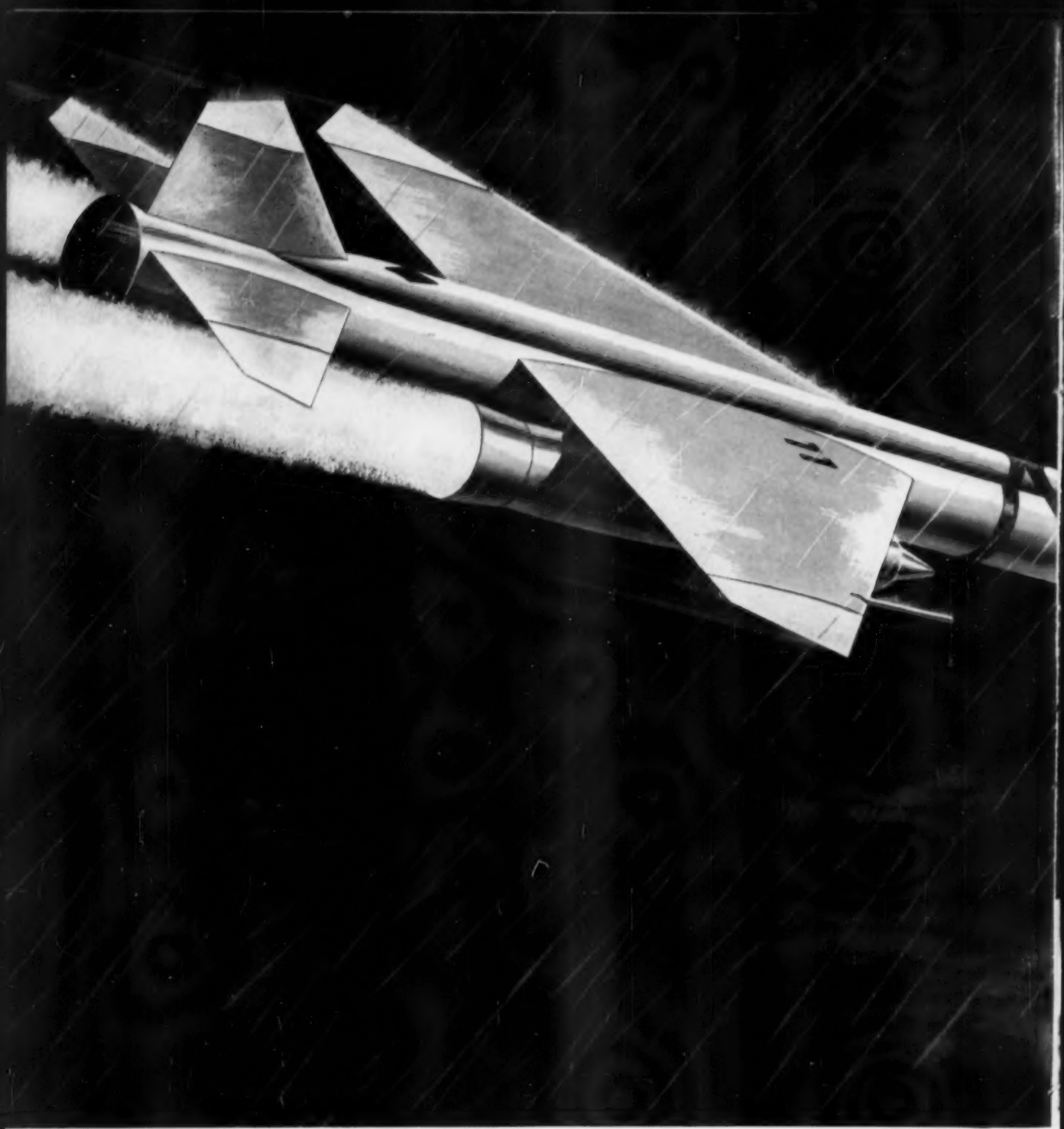

# Westinghouse All-Weather System Guides

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# PLANE FAX

*by* STANDARD OIL COMPANY OF CALIFORNIA

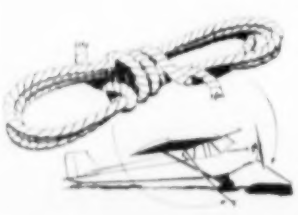
## De-icing phone lines in the high Cascades

"Just like flying brooms!" That's what telephone men say about the Bell helicopters used to blow heavy frost from long-distance lines in Eastern Washington.

"Before they started using our 'copters," says Carl Brady of Economy Pest Control Company, Yakima, Washington, "men on foot had to try to clean the wires by hitting them with poles. Now, the downdraft from our ships does the whole job in a couple of hours.

"Flying around those wires can be tricky, but it's just another job to us. We do plenty of tough flying but we've never had a bad accident. Partly because of Chevron Aviation Gasoline. We use it in all our craft, and it gives us full power every time we need it. Never fouls plugs, either, and that's really something in a helicopter.

"Because of our government flying, we have to major every 600 hours. But using RPM Aviation Oils, we always take the extra 60 hours we're allowed, and even then the engines are perfectly good when we take them down. From what we've seen, 'RPM' would keep our engines in top shape for 900 hours. It's the best oil we can buy."



### TIP OF THE MONTH

High winds with gusts are common this month in many areas. New ⅞" manila rope, double-stranded, will make a safe tie-down—don't risk your plane for the sake of an older piece of cordage.

*We take better care of your plane*

CHEVRON AVIATION GASOLINE

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T.M.'S "RPM," "CHEVRON," "PLANE FAX," REG. U. S. PAT. OFF.

## Hoist Designed for Transmitter Lifting

This 500 lb. lifter is one of three in service at New York International Airport where it helps remove and replace 80 lb. UHF transmitters used for ground-to-air radio communications by the Civil Aeronautics Administration. CAA has purchased 1,200 such lifters for use throughout the country, according to the manufacturer, Colson Corp.

Device allows one man to do a job formerly requiring two men. Lifter incorporates a hand crank to wind in or pay out a cable over a pulley to raise and lower a platform which carries the electronic equipment. Built-in safety device automatically locks the platform in position in case of crank or cable failure to prevent damage to transmitters being handled.

Height limits of the device range from 3 in. to 63 in. from the floor. Lifter is mounted on rubber-tired wheels two of which are swivel-mounted. Colson Corp., wholly-owned subsidiary of Great American Industries, Inc., is located in Somerville, Mass.

## OFF THE LINE

**Small volume,** high pressure, electric motor-driven positive displacement hydraulic pump is being produced by Lear-Romec Division, Lear, Inc.

Rotary gear pump is designed for intermittent duty at temperatures ranging from 65F to +255F, pumping hydraulic fluid per Mil-9-5605 with inlet pressure of 10 psi. absolute. Capacities of the unit are 0.025 gpm. at 18 v. and 0.059 gpm. at 30 v., both with 1,000 psi. discharge pressure. Pump has an emergency duty rating of 0.015 gpm. with 1,600 psi. discharge pressure. Volumetric efficiency is 95%.

**Floating suction** unit for airport fuel storage tanks which features a low torque swivel joint has been developed by the British firm, The Emco Brass Manufacturing Co., Ltd.

Suction inlets are floated 12-14 in. below surface of the fuel to avoid picking up water and sediment in the bottom of the tank and also to avoid creating a vortex on the surface of the fuel during high pumping rates. Former floating suction units incorporated packed type swivel joints whose high torque eventually prevented automatic flotation, according to Emco.

Baffle plate across the intake orifice prevents disturbing precipitate in the bottom of the fuel tank as level falls. A foot keeps the orifice from dropping more than 9 in. from the tank bottom. Flow capacities are 200 gpm. for a 4-in. diameter orifice and 500 gpm. for a 6-in. unit. Orifice sizes are available from 1½-8 in.


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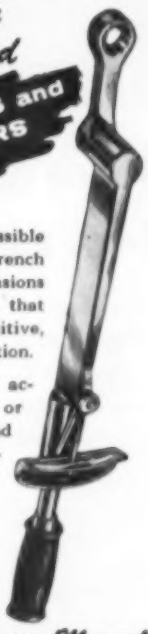

**It is mechanically impossible to use any Torque Wrench with adapters or extensions (with accuracy) unless that Torque Wrench has a positive, built-in, fixed load position.**

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**with formulas tables and explanations for correct use of adapters and extensions.**

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## radomes by McMillan... developed and delivered to meet Canadair's roll-out date (scheduled 2½ years before)

Named ARGUS after the "watchful guardian" of Greek mythology, Canadair's CL-28 carries the most comprehensive collection of electronic and other detection equipment ever assembled into one aircraft for locating, tracking and "fixing" enemy submarines. It has a number of radar "eyes".

The radomes for these "eyes" were developed by McMillan Industrial Corporation.

For the forward antenna, McMillan developed, manufactured and tested one of the largest radomes ever built – measuring 16′ long x 8′ wide x 8′ deep. Tremendous in size, this radome had to be designed to be lightweight yet meet rigid electrical, environmental and structural requirements.

Whether your problem is that of a small, accurate missile radome, a mammoth aircraft radome or a ground radar system, you can benefit from McMillan's sixteen years of experience in design, manufacture and testing of all types of radomes.

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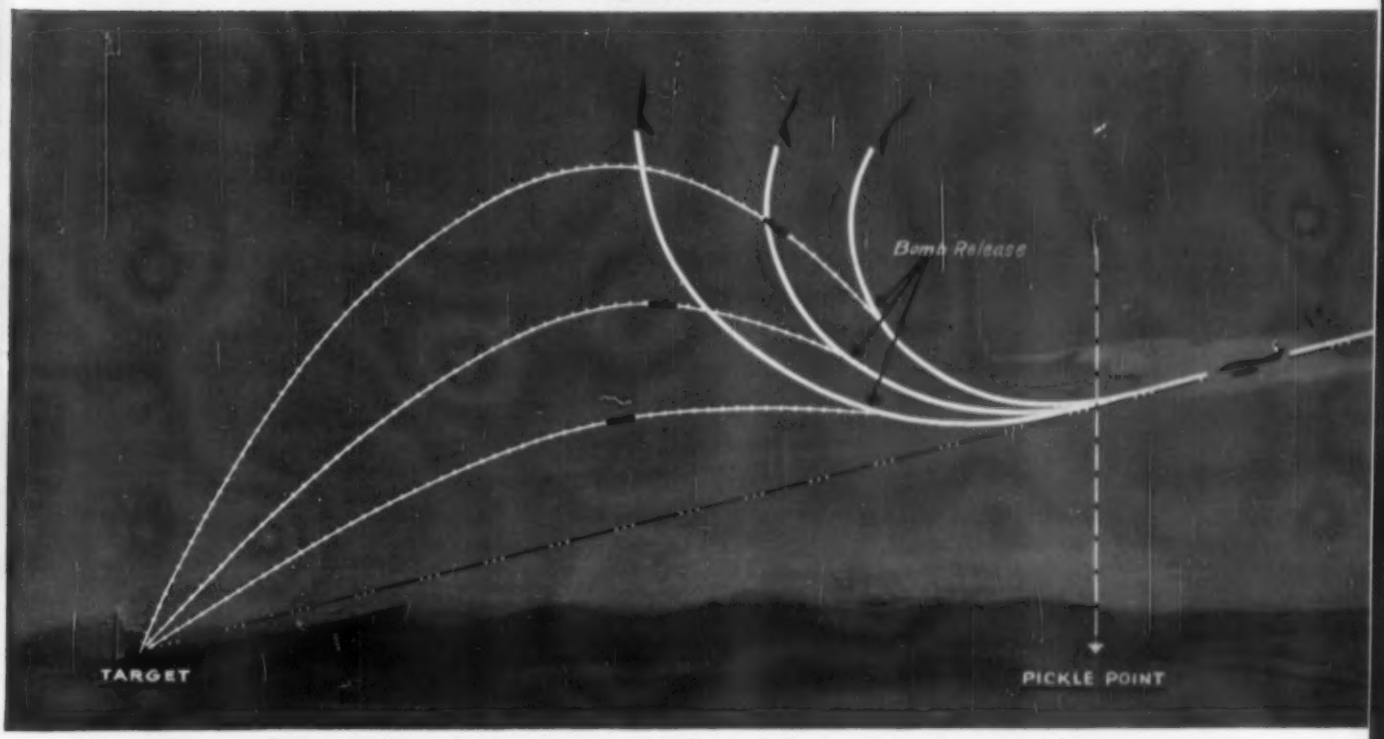



**M-1 toss-bombing system, used on USAF tactical bombers, gives flexibility in choice of targets and in required bombing maneuver.**

# M-1 Toss Bomb System Light, Simple

By Philip J. Klass

**Brooklyn, N. Y.**—Simple, lightweight semi-automatic toss-bombing system which resembles Low Altitude Bombing System (LABS) (AW July 22, p. 62) but reduces airplane exposure to enemy defenses and gives greater tactical flexibility has been revealed by Air Force.

The M-1 system, an outgrowth of a bombing computer originally developed by Sweden's Saab Aircraft Co., was designed and produced here by Mergenthaler Linotype Co. System weighs about 30 lb. and currently is operational in a number of aircraft, including F-100, F-101, B-57, F-86 and F-84F, company reports.

The M-1 is simple to use. Pilot merely locates target and dives at any angle between 7 and 75 deg. (below horizontal). When target is lined up in gunsight crosshairs, pilot pushes "pickle point" button, then pulls up at almost any convenient angle while keeping airplane wings level.

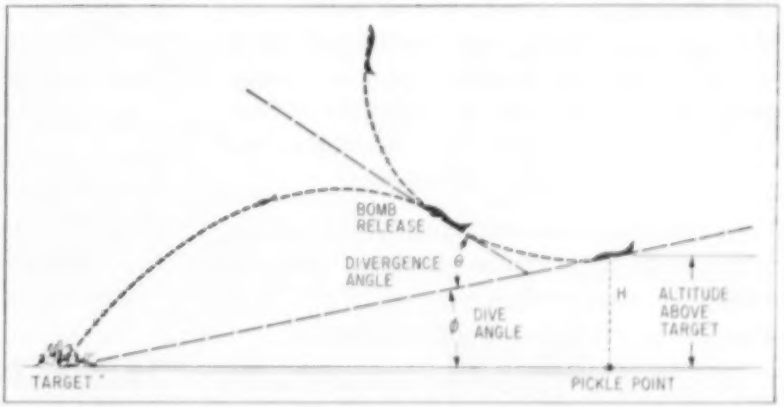
Computer determines precise instant when bomb must be released to hit target and automatically initiates its release.

Mergenthaler claims several advantages for system over the Low Altitude Bombing System.

The latter requires use of a landmark whose distance from target is known in order to compute when pull-up maneuver must begin, or else the airplane must fly directly over what may be a heavily defended target, then execute an Immelmann turn for an over-the-shoulder bomb toss.

The M-1 requires no landmark, permitting its use against targets of opportunity without advance landmarks, and permits the bomber to launch its weapon from a considerable distance out without flying over the target.

Another advantage, according to Mergenthaler's W. O. Grube, assistant manager of systems engineering, is that M-1 does not require pilot to follow any prescribed pull-up maneuver for accurate bomb toss as with the Low Al-




**M-1 toss-bombing computer determines correct bomb release point (divergence angle) from bomber's dive angle and barometric altitude at pickle point plus other preset data.**

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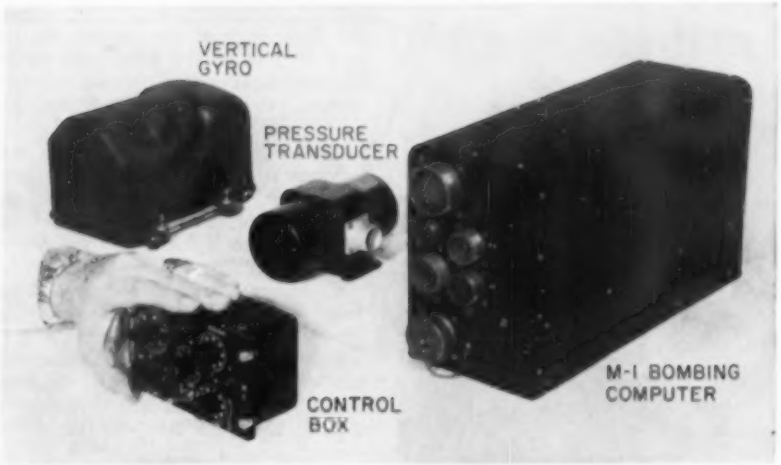


**THIRTY**-pound bombing system consists of computer, control box, gyro and transducer.

titude Bombing System. However, the latter can be used at tree-top levels whereas the M-1 has a low-altitude limit of about 2,000 ft. On the other hand, the M-1 can be employed at high altitudes, up to about 20,000 ft.

### Bombing Geometry

The M-1 employs an extremely simple technique for determining target position at the instant target appears centered on gunsight crosshairs. If bomber altitude (H) above target and its dive angle ($\phi$) relative to horizontal can be measured at the pickle point, these two measurements define position of target relative to pickle point and airplane at this instant.

**THREE**-dimensional parabolic-shaped cam is heart of M-1 toss-bombing computer.

Dive angle can be obtained directly from vertical gyro in the airplane. Aircraft altitude can be established by measuring (barometric) pressure altitude of the airplane and subtracting barometric pressure at the target, previously estimated or determined and set into the computer by the pilot.

Use of barometric pressure to establish target position avoids complexity of using range-only radar or radio altimeter. However, it means that barometric pressure in vicinity of target must be known approximately or estimated. When pressure is unknown, errors in using estimated value will produce some aiming error, the amount depending upon error in the estimate, airplane speed and altitude at pickle point.

### Theory of Operation

The Mergenthaler computer is an analog type device which solves the bombing problem in a classical manner by assuming the weapon is dropped in a vacuum, then instantly introduces corrections for such practical considerations as head/tail winds and aerodynamic characteristics of the bomb.

From instant the pilot pushes the pickle button and begins his pull-out, the M-1 computer continuously monitors airplane pitch attitude, measured relative to the dive angle at pickle point. When aircraft pitch angle has increased by an amount equal to what Mergenthaler calls "the divergence angle" ($\theta$) calculated by the computer, it initiates the bomb release.

Divergence angle computation according to classical (vacuum) conditions conveniently boils down to a function of aircraft dive angle at pickle point and the ratio of static-impact pressure measured at the aircraft. Mergenthaler employs a three-dimensional parabolic ballistic cam to compute divergence angle. Cam is rotated about

Waugh

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Waugh model MF-142 totalizing turbine flowmeter has been selected for the tanker version of the *Douglas A3D Skywarrior* to give precise measurement and control of fuel transfer.

FEATURES:

- Simple, reliable transistor circuitry in flow sensor actuates counter and signal light—no intermediate devices
- Signal light to indicate transfer of fuel is actuated directly from flow sensor
- Slowly rotating turbine rotor is the only moving part—no relays or mechanical contacts

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STanley 3-1033

**PORTABLE** tester, designed by Mergenthaler, permits complete bombing system checkout.

its longitudinal axis by small servo system so its position corresponds to airplane pitch attitude. Cam follows pitch axis changes of the airplane until pilot pushes pickle button which freezes cam position for duration of the problem.

Another servo system positions a cam follower along the length of the three-dimensional cam as a function of pressure altitude/impact pressure ratio based on signals provided by a small transducer. Diameter of cam at any particular location displaces cam follower, rotating shaft of potentiometer whose output voltage is proportional to desired divergence angle based on vacuum conditions.

Data on ballistics of weapon to be dropped, external winds, airplane gross weight and estimated pressure at the target are set into console by pilot prior to attack. The preset data, plus signal from vertical accelerometer which is used for angle-of-attack correction, enable computer to modify aforementioned divergence angle signal to compensate for:

- **Bomb aerodynamic** characteristics.
- **Distance traversed** by airplane from pickle point.
- **Aircraft angle** of attack.
- **Head/tailwind** effect on both airplane and bomb after release.

Modified divergence angle signal is then compared continuously with the signal proportional to change in airplane pitch angle since pickle point. When two angles (signals) are equal, computer releases the bomb.

All computation involving signal voltages is performed on the basis of voltage ratios rather than amplitude in order to make system independent of variations in power supply voltage.

Two identical servo systems are employed, one of them performing double duty. The servo system employed to rotate the ballistic cam in accordance with airplane pitch attitude is free for another task when the pilot pushes his pickle button and freezes the cam position.

The same servo amplifier then is used to compare computed divergence angle signal with signal representing change in airplane pitch angle from the original dive angle. Magnetic amplifiers, with single tube pre-amp, are used in each servo amplifier.

A two-dimensional cam, driven from the same shaft as the ballistic cam, is used to provide the pilot with an indicating light which shows whether aircraft pitch angle, altitude and airspeed are within suitable range of values to permit successful bomb toss.

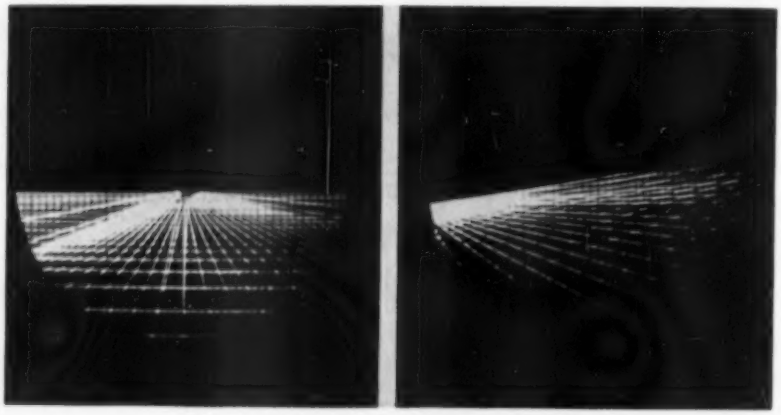
Mergenthaler has developed a complete line of line maintenance and depot test equipment for the M-1 system, including a system analyzer which permits bombing run simulation.

Company has developed new "black box" with corporate funds which can be added to M-1 system to extend its operating range and tactical capabilities. The improved system is being evaluated at the Air Force Armament Center, Eglin AF Base, Florida.

## FILTER CENTER

▶ **New Radio Telescope**—An 85 ft. diameter radio telescope, largest of its kind in the United States, will be installed near University of Michigan campus at Ann Arbor, under Office of Naval Research sponsorship next spring. The parabolic shaped dish will employ equatorial mounting with its polar axis aligned with the North Celestial Pole and will be rotated about east-west direction to compensate for earth's rotation. Dish also can be rotated 140 degrees in elevation. Installation is being designed and built by Blaw-Knox Co.

▶ **Semiconductor "Bureau of Standards"**—New semiconductor industry facility designed to standardize techniques employed to measure critical transistor and diode characteristics is being set up at Syracuse University by Electronic Industries Association (formerly RETMA). New semiconductor laboratory is pat-



## Simulated Contact Flight

**Contact flight display of basic flight information is simulated in new Army-Navy panel by analog generator which produces rectangular earth-grid structure on flat TV tube. (AW Nov. 4, p. 96.) Display at left shows aircraft in level flight, headed in north-south direction. At right airplane is headed northeast with nose and right wing down. Analog computer for display was developed by Allen B. Du Mont Laboratories.**

## Who's Who In Countermeasures

**Avionics firms active in electronic countermeasures, in addition to those listed earlier (AW Nov. 18, p. 50) include: Admiral, General Electronics Laboratory, Instruments For Industry, McMillan and Systems Inc.**

terned after similar facility for vacuum tubes operated by Radio Corporation of America for the tube industry. Syracuse University also will test alternate source semiconductors to establish whether they have some characteristics as primary source devices.

▶ **Handy Reference**—Wall chart containing reference table of commonly used conversions, such as atmospheres to kg. per sq. cm., cm. per second to mph., microns to meters, etc., is available for the asking from Precision Equipment Co., 4411 E. Ravenswood Ave., Chicago 40, Ill.

▶ **Inertial Palsy, Anyone?**—Taking a cue from TV hucksters, North American's Autonetics Division is seeking to drum up inertial guidance business with a clever folder addressed to "Missile and Sputnik drivers: Are you the victim of a shaky stable platform? Are you bothered by aching azimuths, galloping gimbals, throbbing bearings, overweight rotors, calypso Coriolis, or undigested feedback? Do you suffer from the dread three-axis drift? Don't take a chance on a tyro gyro. . . ."

## Expansions, Changes In Avionics Industry

Clifton Precision Products Co., Clifton Heights, Pa., has purchased 33,000 sq. ft. facility in Colorado Springs for manufacturing synchros and other avionic components. New acquisition will double company's manufacturing capacity.

Other recently announced expansions and changes in the avionics field include:

• **Hyperion, Inc.**, West Newton, Mass., is a newly organized company which will manufacture a.c. to d.c. and d.c. to d.c. power supplies and converters employing transistors. Company's address: 1447 Washington St.

• **Cubic Corp.**, San Diego, has purchased **Digital Inc.**, of the same city, expanding the former's line of instrumentation and automatic control.

• **Assembly Products, Inc.**, has made 2,000 sq. ft. addition to subsidiary plant in Desert Hot Springs, Calif. Company manufactures moving coil meter relays.

# More Canadian Participation Urged In U.S.-Canada Electronic Defense

By James A. Fusca

**Quebec City**—Present joint U. S.-Canadian Pinetree line, established for ground controlled interception of enemy bombers, is inadequate for present and anticipated needs, according to a Canadian avionics manufacturer.

K. R. Patrick, president of Canadian Aviation Electronics, told a meeting of the Aviation Writers Association here that the Pinetree line does not provide the depth of radar coverage and capacity for controlling large numbers of manned and unmanned interceptors necessary for an effective defense against supersonic bombers.

In recommending an immediate program of expansion, he stated, "My case is specifically for a large Canadian participation in the development and manufacture, installation and operation, of (the Canadian) electronic ground environment. This should be a prime responsibility of Canada's defense planners."

### Ground Environment

Present electronic ground environment in Canada includes the DEW line, the Mid-Canada line and the Pinetree line. The first two lines act as warning nets, alerting the Pinetree defense complex to an impending attack.

Patrick said that the existing Pinetree line does not meet the minimum requirements for successful defense against present and anticipated methods of enemy attack.

To meet these requirements, he said, radar coverage must be expanded to a minimum depth of 700 mi. and the capacity expanded to control a large number of simultaneous interceptions both by ground-air missiles of the Bomarc type and manned interceptors such as the 1,500 mph. CF-105 Arrow.

Systems for defense against intercontinental ballistic missiles also must be integrated into the Pinetree line defenses and be operational by 1962 at the latest, he said. Such defense requires a highly automatic long-range detection and anti-missile control system in the electronic ground environment. This is North America's, and therefore Canada's defense need, he added.

According to Patrick's estimates, Canada should spend something on the order of $2 billion in the development and procurement of this electronic ground environment during the next 10 years.

The development of this environment should be a zealously protected Canadian responsibility, he said.

Development and manufacture of air defense weapons, which are such important parts of the aircraft industry in Canada today, he continued, should be for the overall North American inventory on a basis of some equitable sharing of the costs between Canada and the U. S. to achieve at least a full utilization of the Canadian aircraft industry.

Patrick stressed that this policy would appear to be a logical expression of the integration of Canadian-American air defense. "The logic appears sufficiently compelling to overcome the resistance to such American purchases in Canada that might be fostered by the very powerful aircraft lobbies in Washington."

### Canadian Success

He cited the success of Canadian-built aircraft such as the CF-100, the T-33, the F-86, and the anticipated success of the CF-105 Arrow and the CL-28 Argus as evidence supporting a Canadian aircraft sales program to the U. S.

Greater emphasis on the Canadian electronic ground environment was recommended for the following reasons:

• **No meaningful air defense** is possible without it.

• **Canadian ownership** of the ground environment system would give the RCAF in Canada control over all interceptors, manned and unmanned, whether they are Canadian or allied. Such ownership would give Canada a much stronger voice in the integrated North American defense structure and is perhaps vital to Canadian sovereignty as well.

• **With civil and military cooperation,** most of the electronic ground environment can be valuable to air transportation, and will be increasingly so as air traffic density and speeds increase.

• **Logistic support** of the bases can be an important stimulus in development of air transportation.

• **Canada could relieve the Americans** of the operation of the Canadian part of the existing ground environment (for example, along the DEW line) which is costly from the American point of view.

• **Emphasis on ground environment** supports a strategically important industry. It would allow for a much more economic procurement in Canada of ground environment equipment if the industry could support the whole rather than a small part of the total system in Canada.

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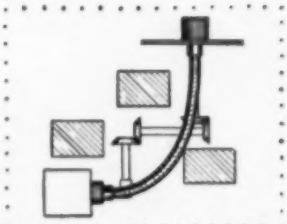

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**CRUISING RANGE** of Tri-Pacer 160 Seaplane, with optional tank, is 525 mi. Demand for aircraft is high from sports-minded pilots.

*Aviation Week Check Flight:*

# Floats Add Versatility for Tri-Pacer

By Robert I. Stanfield

**New York**—Typical Tri-Pacer flight characteristics, coupled with extra power of its high-compression Lycoming O320-B engine, make the 160 Seaplane easy to handle and well suited for land-to-water pilot transition, AVIATION WEEK found in seaplane flight evaluation.

Tri-Pacer itself is basically similar to previous models (AW Nov. 4, p. 114). Main differences lie in interior restyling and the 160 hp. Lycoming, which costs $200 more than the 150 hp. and generates 2,700 rpm. at takeoff.

Key features of 160 Seaplane include:

• **Additional 10 hp.** of the O320-B four-cylinder, air-cooled Lycoming. Weight increase with added power is but 6 lb. Compression ratio is 8.5 to 1. Fuel consumption averages .45 lb. of fuel per hp./hr., a 10% saving over former .50 lb.

• **Aluminum Alclad Edo floats,** Model 89-2000. Each float incorporates six separate watertight compartments. Each alone will support 2,000 lb. fresh water displacement, leaving a reserve buoyancy of 100% on the fully loaded seaplane.

Seaplane also differs from tricycle-geared 160 in these respects:

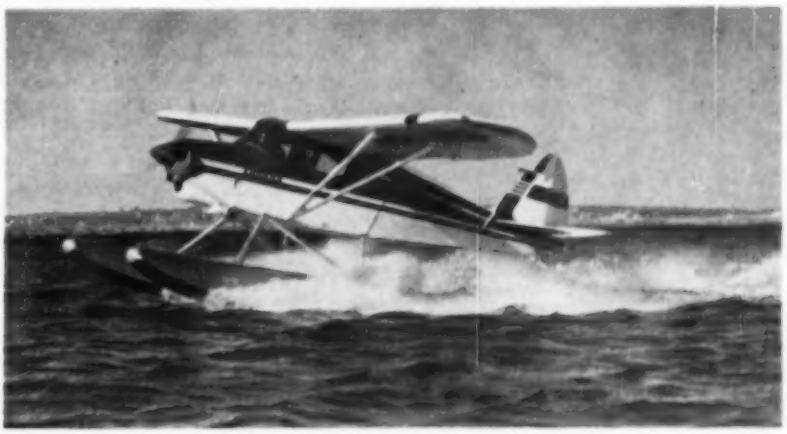
• **Net difference in weight** of 180 lb., due to addition of floats which, with installation, average about 264 lb. Empty weight of standard seaplane is 1,290 lb.; that of wheeled Tri-Pacer is 1,110 lb.

• **Useful load difference** of 230 lb., again due to additional weight of floats. That of seaplane is 660 lb.; figure for tricycle-geared Tri-Pacer is 890 lb.

• **Addition of ventral fin,** which adds to seaplane's stability.

Tri-Pacer was picked up at Sky Harbor on the Hackensack River, Carlstadt, N. J., for flight to Oyster Bay, N. Y.

Seaplane we flew was prototype Tri-Pacer 160, Super Custom model, N6844B. With two of us aboard, plus 23 gal. fuel (91/96 octane is specified),



**USE OF FLAPS** on takeoff will lift Tri-Pacer quickest from "step" into air.

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***Super Anscochrome 16 mm Film***

## Piper Tri-Pacer 160 Seaplane—Model PA-22

SPECIFICATIONS

| | |
|---|---|
| Engine | Lycoming O320-B |
| Hp. and rpm | 160 at 2,700 |
| Gross weight (lb.) | 1,950 |
| Empty weight (lb.) | 1,290 |
| Useful load (lb.) | 660 |
| Wing span (ft.) | 29.3 |
| Wing area (sq. ft.) | 147.5 |
| Length (ft.) | 22 |
| Height (ft.) | 8.6 |
| Prop diameter (max. in.) | 74 |
| Power loading (lb./hp.) | 12.2 |
| Wing loading (lb./sq. ft.) | 13.2 |
| Baggage capacity (lb.) | 100 |
| Fuel capacity (standard, gal.) | 36 |

PERFORMANCE

| | |
|---|---|
| Top speed (mph.) | 117 |
| Cruising speed (75% at sea level, mph.) | 107 |
| Optimum cruising speed (75% power, 7,000 ft., mph.) | 112 |
| Stalling speed (mph.) | 58 |
| Best rate of climb speed (mph.) | 75 |
| Rate of climb (fpm.) | 750 |
| Best angle of climb speed (mph.) | 65 |
| Best angle of climb ratio | 1/9 |
| Service ceiling (ft.) | 15,300 |
| Absolute ceiling (ft.) | 17,500 |
| Fuel consumption (75% power, gph.) | 9 |
| Cruising range (mi.) | 430 |
| Cruising range (optional tank) (mi.) | 525 |

8 qt. oil, and 40 lb. equipment, seaplane grossed out at about 1,823 lb.

Maximum allowable gross weight is 1,950 lb. Seaplane, therefore, is two- or three-place, depending on amount of fuel carried.

Weather conditions were excellent for seaplane transition. Wind was from the SSE at 10 kt. Sea level pressure was 30.04 in. (1031.8 mb.). Outside air temperature was 50F.

### Float Dimensions

Seaplane rode from hangar to water on dolly. Inspection of floats showed they were attached to fuselage by clamp-on fittings. No welding is necessary. Total skin area of float is 87 sq. ft. Length of each is 16.3 ft. Maximum height is 22 in.; beam, 28 in.

Internally, floats, also used on PA-18 seaplane, are finished with two coats of zinc chromate paint. Externally, they get two coats of aluminum lacquer.

Full float package runs $3,080, which is added to price quoted for tricycle-geared Tri-Pacer. This includes base floats price of $2,570, plus $250 for installation at Piper factory, $60 for float plane kit, including extra fin, and $200 for metalizing, which is necessary for salt-water operation.

In metalizing seaplane, all steel members are sandblasted and sprayed with molten aluminum.

Piper offers seaplane in three models: Standard, priced at $11,675; Custom, at $12,350, and Super Custom, $13,555.

Seaplane was boarded via catwalk on floats and easy step-up to cabin. For water taxiing, small water rudder at rear of right-side float is linked to rudder pedals. Controlled mechanically from pilot's side of cockpit, it is retracted during flight; dropped for water operation only.

Tri-Pacer sat well on water; visibility was good. Water-taxiing required more power application—1,000 to 1,500 rpm.—than would be used with wheels and more forceful rudder pressure.

River wasn't choppy and taxiing was smooth, floats riding high on water. Where sharp turn was necessary seaplane could be swung around nicely with short burst of power, which increased rudder control.

### Start of Takeoff

Just before takeoff we ran through check list centered on instrument panel on pilot's side, then throttled around into the wind. Water rudder was retracted and seaplane weathervaned straight down "runway."

One school of thought suggests taking Tri-Pacer off water using no flaps to start, then half flaps to pull seaplane off the step. We got good results by starting our run with half flaps.

Half flaps were dropped to help pull floats to top of water quickest and get seaplane on the step. Full power was applied and wheel pulled straight back to aid in bringing up floats.

Seaplane bumped fast down the river, float hulls smacking against water. Straight-ahead visibility wasn't too good, with our nose-high attitude. Speed quickly increased to 55 mph. and seaplane was riding high on the step.

At this point we relaxed back pressure somewhat and seaplane was in normal takeoff attitude. Full flaps were dropped and we were airborne immediately afterward, at about 60 mph.

Seaplane climbed out easily. Flaps were milked up, one notch at a time, at about 100 ft. with no fall-away evident. At 1,000 ft., pulling 27.5 in. MP and 2,500 rpm., we were climbing at between 900-1,000 fpm. and varying airspeed from 90 to 95 mph.

Specifications indicate 75 mph. to be best rate of climb speed. With our weight, pulling climb power, we found climb angle at this speed to be too steep. But at 90 mph. we got best visibility, good angle and, of course, increased climb speed.

At 2,000 ft., pulling 25.5 in. MP and 2,500 rpm., we did drop back to 75 mph. IAS and retained 900 fpm. rate of climb. Seaplane was quite stable during ascent and with slight trim could be flown hands off.

### Engine Settings

We leveled off at 3,000 ft. Outside air temperature was 42F. We were pulling 24 in. MP and 2,500 rpm. At 75% power our TAS held about 115 mph. Airspeed is redlined at 170 mph. The Tri-Pacer felt comfortable and we didn't have to raise our voices to talk. Inside air temperature was held constant through push-pull controls operating front and rear seat heaters.

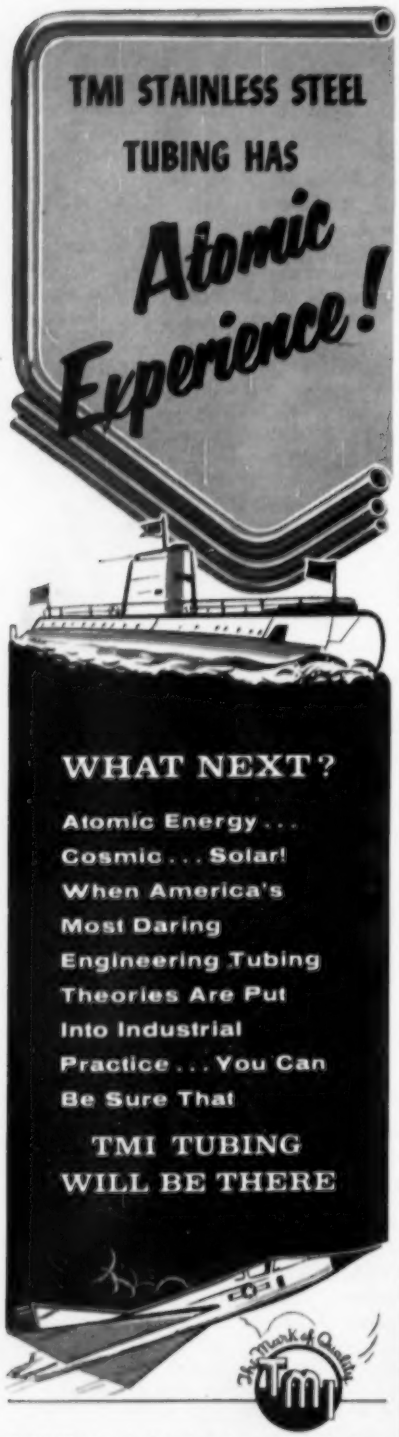
During flight to Oyster Bay we ran through various degrees of banks and stalls. Interconnected control system made for easy coordination. When wheel is turned, ailerons bank seaplane and rudder automatically cuts in the desired amount.

Throughout evaluation seaplane showed stability typical of tricycle-geared Tri-Pacer.

Seaplane was stalled at cruise altitude, using no flaps and full flaps, with 15 in. MP and with power full off.

With no flaps, and power, Tri-Pacer stalled reluctantly. Lateral stability was good all the way through. Buffeting wasn't very heavy and seaplane broke at about 54 mph. IAS. With full flaps, stall again was preceded by buffeting. Stall speed was about 47 mph. indicated. There was little strain in keeping wings level and in both instances loss of altitude was negligible.

Power off, with no flaps, did not result in a clean stall. Rather there

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was a mushing out at 60 mph. IAS, which was easily restricted by application of power. When flaps were extended we again began buffeting well ahead of another hesitant stall which came at about 55 mph. indicated.

Landings at Oyster Bay were simplified by lack of tower and immensity of "runway." We shot about a half-dozen, in most instances applying a bit of power and holding airspeed to about 75 mph. on approach. With full flaps, and holding nose slightly high so that floats wouldn't "dig" when we touched down, we'd fly seaplane onto water. As with takeoff, wheel would be pulled full back after touchdown.

Surprisingly, for the first time out, most of the landings, with this technique, were satisfactory. Floats would cut smoothly through water and "landing roll" would quickly stop.

We goofed once, and dropped our nose as we retarded power too soon. Seaplane hit on round-out. A little throttle, plus back-stick to regain nose-high attitude, brought her down from the bounce.

Throughout succession of landings and takeoffs there was no spray tossed on windshield. Floats held seaplane well balanced in water. Tri-Pacer was quite dry. We didn't even get our feet wet when we beached the seaplane.

### Beaching and Reboarding

We taxied seaplane onto beach, cutting switch just before forward end of floats ran over sand. Before reboarding, light Tri-Pacer was eased backward into water, then swung around by wingtip until aft end of floats extended over sand, from which we hopped aboard.

Cruising range of the 160 Seaplane is 430 mi. which, with optional eight-gal. auxiliary tank installed, can be increased to 525 mi.

About 3-4% of total Tri-Pacer production has run to floats, AVIATION WEEK was told. Market is fairly regional and runs to big-water areas such as New England states, Michigan, Pacific Northwest, Louisiana and Mississippi, etc. Demand for seaplane is also high from sports-minded pilots.

Baggage can be loaded from outside baggage door just aft of cabin entrance. However, rear seat can be quickly removed to provide 42 cu. ft. of cargo space.

All Tri-Pacer models come equipped with ash trays, five cabin ventilators, crossover exhaust, dual controls, dual ignition, Duroclad plastic finish, electric fuel gages.

Instruments include airspeed, altimeter, ammeter, compass, oil pressure and temperature, tachometer. Propeller is metal Sensenich. Starter, 20 amp. generator and 33 amp. battery (12 v. system) are incorporated.

### Navigation Equipment

Custom model Tri-Pacer includes navigation and instrument lights. Radio equipment embraces Narco VTA-3 27-channel VHF transmitter with frequency spread 118 to 127 mc.; Narco LFR-3 receiver, 200-400 kc. range, 500-1,700 kc. broadcast; radio homing loop and sensitive altimeter.

Super Custom includes all previously mentioned equipment plus: Narco Superhomer radio (replacing VTA-3 of Custom model) with omni, VHF receiver of 108 to 127 mc., 12-channel VHF transmitter, Narco LFR-3 receiver, and following instruments: artificial horizon, directional gyro, eight-day clock, MP gauge, outside air temperature gauge, rate of climb indicator, turn and bank.

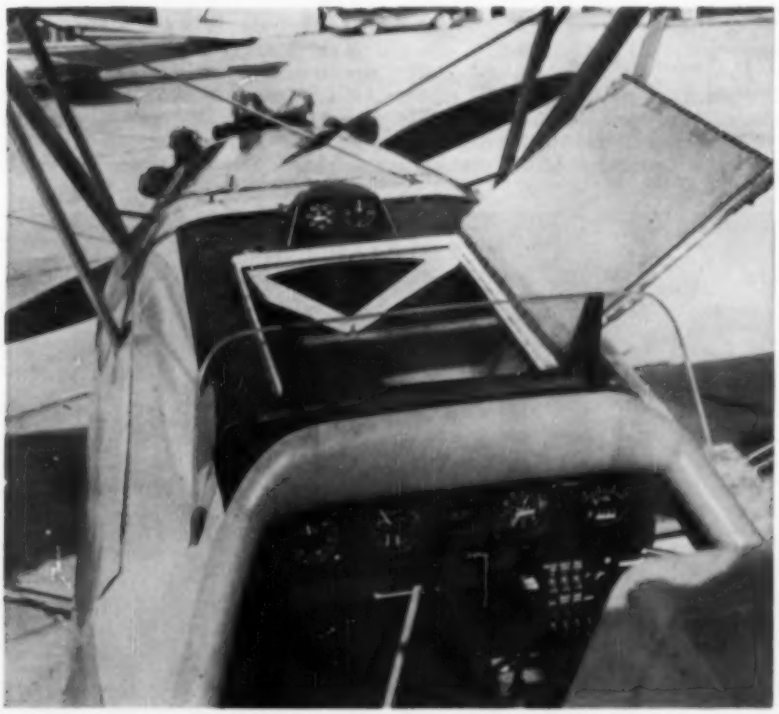
Standard Tri-Pacer color scheme includes white with either red, blue or brown, with interiors to match. Seat covering is Nylo-saran, which can be damp-wiped.

## Champion Makes Foreign Flyaway

**Three of four Champion Travelers and Tri-Travelers, earmarked for foreign operations, are shown at company's factory at Osceola, Wis., prior to flyaway delivery. From right to left: deluxe and standard Travelers for Chile, equipped to use spray tanks and nozzles, and Tri-Traveler for Argentina. Fourth plane, Tri-Traveler for Canada, is out of sight at right.**

**GRUMMAN SPRAYER** makes typical agricultural plane pass low over Red Bird Airport, Dallas, Tex. during recent demonstration tour in South (AW Nov. 25, p. 32-33). Wisps of spray may be seen coming from nozzles projecting below wing leading edges. Sharply slanting nose provides pilot with clear view ahead. With 220-hp. Continental engines, prototypes will take off in 610 ft. at 3,500 lb. gross weight, have stall speed of about 38 mph.

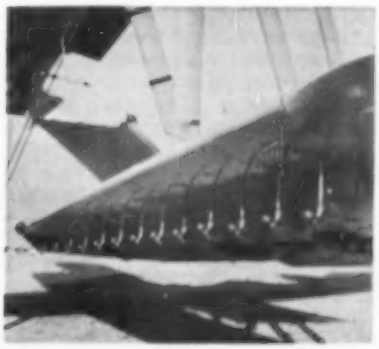
# Grumman Displays Spray-Dust Biplanes



**CHEMICALS HOPPER,** with loading door open, is located just ahead of the single cockpit. It has 29 cu. ft. volume and can take 1,000 lb. of material. Airspeed indicator and tachometer are set just ahead of hopper so pilot can watch instruments without looking down in cockpit while flying. Cockpit coaming is heavily padded to protect pilot in event of an accident and area around pilot is especially braced to provide crash safety integrity.

**LARGE TAIL** is designed to provide good control at low speeds; turnover structure is in headrest.

**PROPELLER** drives pump for spray gear, also agitates chemicals in hopper to dispense load evenly.



**SPRAY NOZZLES** project from booms buried in wing leading edges. Trailing edge units can also be used.

**SIMPLE LANDING GEAR** (below) uses spring-steel struts. This version has dust hopper between gear.

**PROTOTYPE GOOSE CONVERSION,** with one of its four supercharged Lycoming GSO480 engines in place, details engine mountings for other powerplants. Other features include wrap-around windshield with additional panels on upper right and left, retractable wingtip floats.

# Conversion Gives New Look to Amphibian

**New York**—Initial interest by business firms in McKinnon Enterprises' four-engine modification of the prewar twin-engine Grumman Goose amphibian (AW Nov. 25, p 23), indicates that firm orders will be placed as soon as the airplane receives Civil Aeronautics Administration approval.

Several companies have shown their intention to purchase the conversion by buying surplus Grumman Goose amphibians and holding them in readiness for completion of the prototype's flight test program at McKinnon's, Sandy, Ore., facility, so as to obtain an early production priority, AVIATION WEEK has learned.

Prototype is expected to fly this month and final CAA approval will probably be obtained early next year. The airplane will then be ready to start a nationwide flight demonstration tour in the spring. Although initially only a handful of orders have been indicated to date, company expects to develop reasonable sales volume after it is able to give prospects a first-hand demonstration.

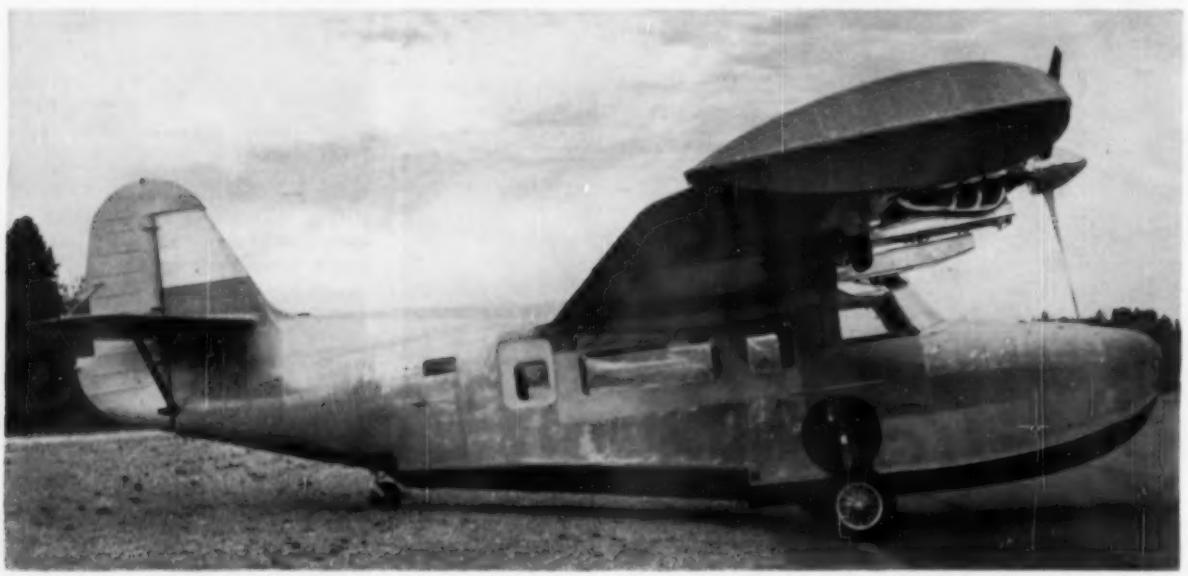
The market potential for the airplane is approximately 50-60 units, a source close to the company told AVIATION WEEK.

### Not Talking Price

Firm is not yet talking firm prices for the airplane, but a ballpark guess is that if the customer furnishes a basic airplane for conversion, it will cost some $125,000 complete. If McKinnon provides the complete package it could run $200,000-$225,000. Firm has not yet taken any money from customers against future deliveries; entire cost of the prototype conversion is being borne by McKinnon.

Nor will McKinnon detail performance figures until after the flight test program has been completed. But it feels that the airplane should be able to cruise at 200 mph. true airspeed at 10,000 ft. on 62% power and will get off the water at 11,000 lb. gross weight in 10 sec.

It expects that the airplane will have exceptional water handling characteristics, particularly in landing in small areas and in water maneuvering, due to



**LARGE DORSAL FIN** has been added to provide engine-out stability. Reinforced plastic radome will extend nose about 20 in. Feature of cabin is extra passenger visibility by use of picture windows. Wingtip floats are actuated by a single electrically operated strut.

reverse pitch feature on all four propellers. Also, the retractable wingtip floats can be actuated individually, permitting the airplane to be brought directly alongside a dock for loading or unloading by retracting the proper float and swinging the wing over the dock. Reversing feature on all four engines will also expedite backing the airplane off a beach.

McKinnon contracted conversion design to a West Coast aeronautical engineering firm and has been working closely with Civil Aeronautics Administration in getting paperwork approved on components as it is going along. Airframe already has undergone considerable testing, including vibration studies and dead-fall landing gear drop tests.

### Nature of Rework

Major rework included strengthening landing gear bulkhead to take landing loads that will be imposed by increase of gross weight by 3,000 lb. over original Goose, moving a rear fuselage bulkhead back to enlarge cabin and provide lavatory space. Additional redesign provides for completely new cockpit arrangement including curved bird-proof windshield and large picture windows in cabin. A large dorsal fin has been added to provide additional stability for engine-out performance. Nose is being lengthened approximately 20 in. with a reinforced plastic structure capable of housing weather radar equipment. Nose will be faired into the hull and is being installed without disturbing major structure, AVIATION WEEK was told.

Main landing gear will use Grumman Mallard amphibian wheels and brakes, but will retain Goose strut structure. But, should pilots express preference for wider track gear, McKinnon probably will incorporate Mallard-type retraction system with shock strut extending from under the wing in later conversions.

Wingtips have been extended 18 in. on each side to provide additional area to handle gross weight increase. Wing covering is now all metal, in place of former metal and fabric covering.

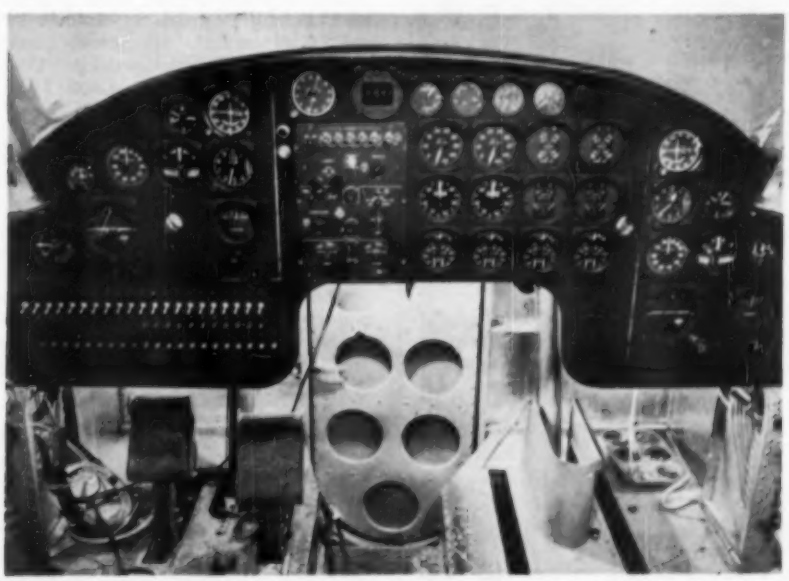
### Actuating Systems

Actuating systems have been completely revised—the new airplane uses electrical power for landing gear, flaps, wingtip floats and other services.

Because of the market for which this airplane is aimed, and because of its price range, McKinnon plans to farm out the interior work to a specialist in this operation. It is negotiating with Horton & Horton, Ft. Worth custom interior firm, on preparing the prototype for its demonstration tour.

McKinnon Enterprises has considerable experience in amphibian conversions. Founder, a former heavy contractor on dikes, seawalls and road construction, got into the aviation business by modifying his own Grumman Widgeon four-place amphibian from Ranger to Lycoming powerplants.

This program worked out so successfully that firm has sold some 75 Super Widgeons thus far, expects to reach 100 by time number of airplanes available runs out. McKinnon has since given up his former interests and gone completely into aviation. Aside from negotiating factory sales in a territory from roughly west of the Rockies, the firm has a single sales representative, Welsch Aviation Co., New York City, which covers area east to the Rockies.



**PROTOTYPE'S PANEL** has eyebrow-lighted instrumentation, Aircraft Radio Corp. communications and navigation panel with ADF and dual omnis (left of engine instruments).

## European Trip Made In Aero Commander

President of Southern Sash Sales & Supply Co., Sheffield, Ala., and his administrative assistant recently returned home after a three week good-will tour of Europe in an Aero Commander 680 Super, visiting customers and studying latest technology abroad.

The pair left Muscle Shoals, Ala., early Sept. 27 and flew to Torbay Airport, St. John's, Newfoundland, which was the takeoff point for an entirely overwater leg of 1,530 mi. to Lajes Airport in the Azores. From here they flew 1,250 mi. to Lisbon, then to Madrid, Nice, Monaco, Milan, Rome, Venice, Zurich, Copenhagen, Frankfurt and Paris. Return trip was via Glasgow through Shannon to the Azores, up to St. John's and back to the starting point.

Entire journey covered 17,500 mi., took 80 flying hours. Fuel consumed was approximately 2,500 gal.

President Elton H. Darby and Pilot J. W. Beasley said that service abroad presented no problems; they used Esso and Shell credit cards for fueling. Weather was generally good, although they did use ground control approach and instrument landing system approaches several times. Language was no obstacle, English being spoken at all control towers, and they used this language in all radio contacts.

Southern Sash operates five business planes for salesmen, officials and technicians.

## Indair Buys Vertols For Oil Exploration

An option for three Vertol V-44A utility helicopters has been taken by Indair, Inc., a New York firm that is negotiating with a number of U.S. petroleum firms to provide airlift at oil exploration sites, primarily in Central and South America. Agreement covers more than $1 million in helicopters and spares.

If the option is carried through, this transaction marks the first domestic commercial sale by Vertol of its tandem-rotor V-44 type. Manufacturer also is demonstrating airline and executive versions of the configuration.

Indair expects to take delivery of its first V-44A in January or early February 1958 and begin operations early next year, William Gunther, an official of the new firm told AVIATION WEEK. Company also has prospects for charter work for oil exploration firms in Africa to begin in mid-1958, he added. By this time Indair expects to have six Vertols available. Current prospects are that there will be enough work to keep

the half-dozen helicopters busy for at least three years.

Start of operations in the Western Hemisphere, principally Colombia, Guatemala, Honduras, Venezuela and Bolivia, will hinge on how soon Indair can make necessary arrangements with the governments concerned regarding their operation in each country. Charter helicopter operator plans to set up a separate company in each country where it operates, with ownership of the equipment vested in the parent firm.

Indair has not yet hired necessary pilots and ground crews, although it is interviewing prospects. Plan is to set up a permanent organization rather than hire and lay off personnel for each job, according to operations manager Cal Alston, one-time New York Airways and U.S. Marine helicopter pilot.

Long-range plans include geological survey work and agricultural operations. Indair estimates that its V-44As will be able to carry sufficient chemicals to spray some 1,500 acres per hour.

## PRIVATE LINES

**Trans-polar delivery** flight of Learstar twin-engine business transport from Los Angeles to Dusseldorf, Germany, recently was made in 23 hr. 58 min. total elapsed time for the 6,000 mi. hop, with one fuel stop at Frobisher Bay, Northwest Territories. Flight of 3,055 mi. to Frobisher Bay took 11 hr. 14 min. Normal fuel tankage of 1,340 gal. was used. Plane was delivered to Helmut Horten Gmbh., German department store, by Pacific Airmotive Corp., Burbank, Calif., which manufactures Learstars at Santa Monica.

**Spartan Air Services, Ltd.**, Ottawa, has started operating first of nine Vertol 42-A (H-21) helicopters on mid-Canada radar warning line airlifting personnel and supplies from Hudson Bay to Labrador. Firm operates more than 60 aircraft on aerial survey operations throughout the world.

**Business and private pilots** flying to AiResearch Aviation Service Co.'s Los Angeles International Airport service facility can contact the base directly on 123 mc. (call letters KN4) approximately 100 mi. out to arrange for ground transportation, food, hotel reservations and other services. Communications facility is manned 24 hr. day, seven days a week.

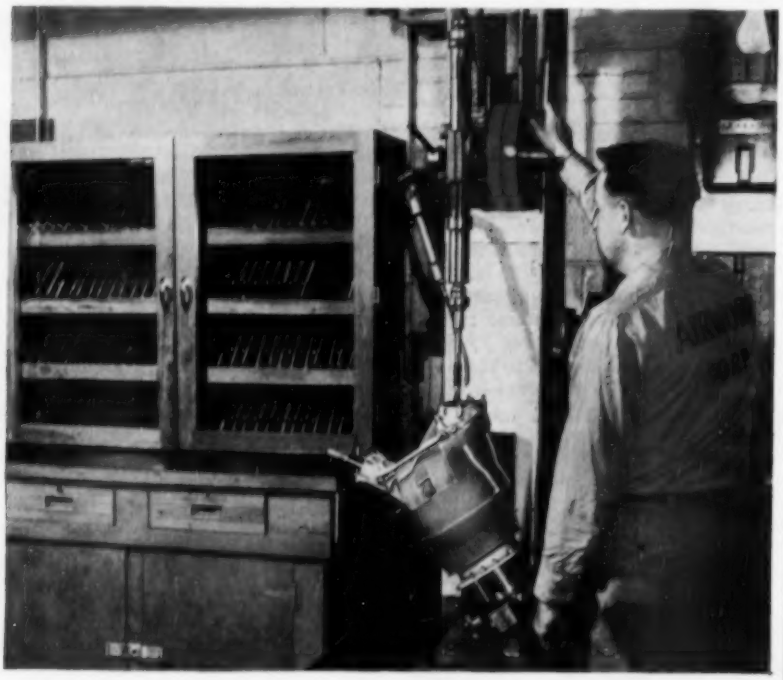
**L. B. Smith Aircraft Corp.** will handle inspection and rehabilitation of 14 Grumman SA-16 Albatross air-sea rescue amphibians for the Brazilian government. L. B. Smith is also responsible for ferrying the aircraft from storage at Tucson, Ariz., to its Miami base and providing ground and flight training for Brazilian crews. L. B. Smith will also overhaul and modify nine B-25s for Venezuelan Air Force.

**New Sensenich M74DR** metal propeller for Cessna 170 and 172 increases cruise speed of these airplanes at least 5 mph. without sacrificing rate of climb, according to the propeller manufacturer. Equipment is also said to be 3 lb. lighter than comparable types and has shorter diameter for increased ground clearance, Sensenich adds.

### Timken Gets Jet

**Paris—Chief executive of Timken Roller Bearing Co., Canton, Ohio, will get the first Morane-Saulnier MS-760 Paris four-place executive jet sold in the United States. Beech Aircraft Corp., which handles sales of the French-built jet, will get two of the airplanes—one for Timken and one for use as a demonstrator. The Wichita manufacturer has eight additional MS-760s on option.**

**Top speed of the Paris is 410 mph. Plane has two 880-lb.-thrust Turbomeca Marbore turbojets. Beech demonstrated the airplane in this country in the summer of 1955 (AW June 27, 1955, p. 44).**

**This Airwork Extra Keeps The Belly Clean!**

Dirty smears on the wing . . . oil drips on the hangar floor. Looks bad! Most of it *could* have been prevented at overhaul.

The overhaul manual allows a 0.006" taper in the valve stem, and a minimum clearance of 0.0045" between stem and guide. Maximum acceptable clearance is 0.0105". But—if you get it—you'll also get oil leaks.

Here's Airwork's answer to this problem: First, hone the stem, reducing the taper to 0.002". Then, custom ream the valve guide to fit the stem. This holds the tolerance between 0.0045" and 0.0065". Result: no leakage.

It takes a high level of careful craftsmanship to use this Airwork procedure. But it produces a smoother running, cleaner engine. (A cleaner airplane and hangar floor, too!) Send your next overhaul to Airwork.

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*CAB Accident Investigation Report:*

# Fatal DC-4 Flight Held 'Haphazard'

Alaska Airlines Douglas C-54B-DC N 90449, was totally destroyed when it crashed and burned approximately 3½ mi. east of Blyn, Wash., about 1719 P.S.T.,[1] March 2, 1957. There were two passengers and a crew of three aboard the aircraft, all of whom received fatal injuries as a result of the accident.

## History of the Flight

Alaska Airlines, Inc., is an air carrier certificated to conduct scheduled operations within the Territory of Alaska and between Alaska and the continental United States. Flight 100 of March 2 originated at Fairbanks, Alaska, as a regularly scheduled nonstop flight to Seattle, Wash. The aircraft, N 90449, had arrived from Seattle at 0717 March 2 as Trip 101/1. Two minor discrepancies reported by the inbound crew were corrected during a turnaround inspection and by 0930 that morning the aircraft was ready for the return flight to Seattle.

The crew assigned to Flight 100, Capt. Lawrence F. Currie, Copilot Lyle O. Edwards and Stewardess Elizabeth Goods, arrived at operations and made the normal routine preparations for the flight. The pilots discussed the flight with the station agent and all necessary flight papers were completed. Weather for the route was given to the pilots. Weight and balance were determined and both were well within allowable limits. The aircraft was serviced with 2,380 gal. of fuel.

The following IFR flight plan was filed with Fairbanks ARTC (Air Route Traffic Control): Alaska 100, a DC-4, departing 10,000 ft. Amber 2 Snag, 12,000 Blue 79 Haines, 10,000 Blue 79 Annette, 9,500 direct Port Hardy, 10,000 Amber 1 Seattle; true airspeed 185; estimating 7 hr. 44 min. en route; proposing 0955.

## Takeoff Accomplished

At 0940 the two passengers and crew boarded the aircraft. Takeoff was made in VFR weather conditions at 0958. Shortly thereafter Fairbanks center called N 90449 and relayed the ATC clearance, approving the flight plan as filed.

Weather conditions at Fairbanks and en route were forecast to be generally good and the flight proceeded in the clear as planned, making routine position reports as it progressed. At 1240, when over Haines, Alaska, at 12,000 ft., Flight 100 canceled its instrument flight plan and informed ARTC that it would proceed VFR to Annette and would file DVFR[2] (Defense Visual Flight Rules) after Annette and before entering the CADIZ (Canadian Air Defense Identification Zone). Thereafter the flight proceeded, reporting its position as DVFR at 1,000 ft. The flight was observed at Patricia Bay, B. C., at an estimated 3,000 ft. msl (mean sea level) by a tower operator. It was also observed leaving the CADIZ.

At 1717 the Alaska Airlines Seattle dispatch office received the following position report by radio from Flight 100: "Dungeness at 16 VFR estimating Seattle at 34." This was the last contact with the flight, which crashed shortly thereafter.

## CAB Investigation

The plane crashed in heavily timbered mountainous terrain March 2 and was not located until March 3, 1957. The crash occurred approximately in the center of the "on course" zone of the northwest leg of the Seattle low frequency radio range, about 11 naut. mi. southeast of the Dungeness fan marker. This leg of the Seattle range defines the center of Amber Airway 1 between the Dungeness intersection and the range station.

The minimum instrument en route altitude for this segment is 5,000 ft. Because of adverse weather and inaccessibility of the location, CAB investigators were unable to reach the scene until March 6. The investigators noted that the wreckage had been disturbed prior to their arrival; some components were missing, presumably carried away by persons unknown.

The path of the aircraft during the final seconds of flight was clearly defined in the heavy timber growing on the steep slope against which the aircraft smashed. The aircraft's first contact with the trees was at a point 650 ft. from the wreckage. From this point it cut a level swath on a heading of 106 deg. magnetic, the width of its wing span, into the steeply rising wooded slope at an elevation of approximately 1,500 ft. msl. The terrain immediately ahead of the aircraft's path rose to an altitude of 2,000-2,100 ft. msl.

Airframe and powerplants were severely damaged as a result of impact followed by intense fire. The wings were torn from the fuselage in its passage through the heavy timber. Parts were scattered from the point of initial contact with the trees along the entire flight path, and as much as 75 ft. beyond the main wreckage area.

## Extensive Fire Damage

All four engines and the main landing gear were wrenched from their positions in the wings. Ensuing fire gutted a major portion of the fuselage remaining and contributed extensively to the damage of other parts.

All control surfaces and their trim tabs were accounted for. However, continuity of controls could not be established because of the severe damage due to impact and fire.

Small portions of the rear main spars for both outer wing panels were recovered with the attachments to the center section spars intact. A section of the left wing, with its flap attached, was found. The flap and its actuating strut were in the full retracted position. Only small fragments of the right wing flap were located, from which no significant determinations could be obtained.

All major components of the landing gear were located. It was possible to establish that the right main gear was retracted. Damage to the nose and left main gear was so extensive that a positive determination of their positions was impossible.

The nose and cabin heaters were recovered and examined for possible malfunction. No stains or indication of leakage of combustion fumes or fuel were evident. All damage to these heaters appeared to be the result of impact.

The empennage, which was almost completely destroyed by the crash, and various other parts of the aircraft were strewn along the flight path from the initial point of contact. The copilot's instrument panel was found relatively undamaged. Subsequent to the accident and prior to the arrival of CAB investigators at the scene, all the instruments had been removed from the panel and stolen by vandals.

## No Malfunction Apparent

The aircraft structure and components which were recovered for examination were damaged as a result of contact with trees and the ground, or by the intense fire which followed the crash. There was no indication of any malfunction or mechanical failure prior to impact.

Complete airframe and equipment maintenance records for N 90449 were carefully scrutinized. These records included, among others, all pilot discrepancy reports, time inspection sheets, maintenance sheets, work sheets, and reports of radio equipment discrepancies. It was determined that all discrepancies had been corrected, all required inspections had been made, and that the airframe and all of its equipment had been maintained in an airworthy condition.

An examination of the powerplants was made. All four engines and the major portions of the propeller assemblies were recovered at the site. The engines were separated from the airframe and sustained heavy damage. The propeller assemblies of all four engines were broken from the power cases. Most of the cowling was stripped from the engines and fell outside the ground fire area. These pieces of cowling showed no signs of fire in flight. Molten metal flow from engine and structure parts, which were subjected to the intense ground fire, indicated that no in-flight fire occurred and that all the burning occurred after the aircraft came to rest.

Examination of the powerplants revealed no evidence of internal failure prior to impact. In the parts available for examination,

[1] All times herein are Pacific standard and are based on the 24-hr. clock.

[2] A clearance which is designated as DVFR is required before entering an Air Defense Identification Zone when VFR.

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The Couch Type 4A relay heads a family of rugged relays — relays that can withstand the extremes of shock, vibration, and acceleration — all because of a unique patented rotary armature design. The 4A design will answer your dry circuit switching problems too. Our Bulletin 132 will tell you more. Write for it today.

**IMPORTANT SPECIFICATIONS**

**Contacts:** 4PDT (4 Form C)

**Size & weight:** 1 3/32" D x 1 1/2" H, 3.2 oz.

**Pull-in power:** 1/2 watt

**Ambient temperature:** -65°C to 125°C

**Vibration resistance:** 20G, 5 to 2000 cps

**Shock resistance:** 75G operating, 200G non-operating

Illustrated on the right are some of the many possible mounting variations available.



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no internal metal contamination, oil starvation or mechanical defect was found.

When the propellers were disassembled, the dome rotating cams of Numbers 1, 2 and 3 were found to be 41 deg., 43 deg. and 41 deg., respectively. The No. 4 propeller dome assembly, distributor valve and front barrel half had been disassembled and the propeller retaining nut mutilated prior to the arrival of the CAB investigators at the scene. The propeller blade shim plates for all engines were damaged in varying amounts. Many were broken and unreadable. On those which were readable the deformation due to impact loading indicated blade angles at impact from 35 deg. to 43 deg. The minimum and maximum angles were obtained from shim plates on Numbers 4 and 3 propellers respectively. Engine maintenance and overhaul records were analyzed. All discrepancies had been properly corrected. All inspections and overhaul procedures were completely and properly conducted.

## In Airworthy Condition

All Airworthiness Directives had been complied with for N 90449. In short, the research indicated that the aircraft had been maintained according to approved schedules and standards and was in an airworthy condition at the time of dispatch.

The investigation by the operations group was extensive. Aircraft logs, flight records, weather records, radio communications and company records were researched minutely. Flight records recovered from the wreckage indicated that the necessary documents had been completed during routine pre-flight preparations. It was noted that the altitudes at which the flight was flown and other in-flight data required by the company were not recorded on the pilot's flight log. The operations agent at Fairbanks had discussed the flight altitudes with the crew, however, and had filed a flight plan specifying the altitudes agreed upon.

At the time of departure a deep low was centered in the Bering Sea and extended eastward to the Fairbanks area. A ridge of high pressure existed along the west coast of Canada. Another ridge of high pressure extended from a high off Southern California northeastward into west Oregon. A weak low level trough extended approximately east-west through the accident area connecting a low pressure cell in Montana with a front approximately five deg. of longitude west of the coast of Washington.

The Seattle terminal weather at the estimated time of arrival of Flight 100 was forecast to be scattered to broken clouds at 3,500 ft. The weather for the northwest Washington area from 0500-1700 was forecast to be clouds at 12,000 ft. scattered to be broken in extreme northwestern Washington, with scud spreading northward across northwest Washington by 0930.

One of the pilots studied weather information available in the Weather Bureau office at Fairbanks. This material included: Surface weather charts, upper air constant level charts, upper winds, hourly reports and forecasts. The pilot requested little assistance from the forecaster who subsequently described the briefing as the "self help" variety. He recalled saying to the pilot, "It looks like you will have a good trip. The weather is mostly clear all the way. Winds are rather strong from a southerly

**A Vought Vignette**
NO. 5 IN A SERIES

# *Why the Missile Engineer Never Missed Mail Call*

Vought's Regulus II missile took shape just a short walk from the desks of its developers. Engineers handled the new hardware and monitored tests in person — literally flying the big missile on the ground at Dallas. It was a convenient arrangement while it lasted.

Then a big USAF Globemaster landed and taxied to Vought's Experimental Hangar. The missile was winched aboard and airlifted to a desert site for flight tests. By nightfall there was a 1,000-mile rift between Regulus II and home base.

Joe Boston was ready to step into this gap. As Project Assistant for Field Liaison, he'd already equipped Vought's desert crew for extensive flight tests. Now he'd make sure that test data and hardware flowed uninterrupted from the desert to Vought. High-speed feedback of facts on one flight could influence the success of the next.

Mail from the desert poured in to Joe at Vought. From project men at the flight test site came parts for immediate rework and return. From the flight test crew's mobile ground station came rolls of telemetered brush records. From the recoverable Regulus itself, came packets of oscillograph data. And from Field Service — for repair or replacement — an occasional wrench or relay.

Joe served as clearing house and consultant. Flight data was reduced and released to design and support groups. It revealed not only missile performance, but the temperatures and pressures of a strange new environment. When data pointed toward design changes, Joe's time and cost estimates helped specialists reach decisions.

Thanks to Vought's fast overland relay of hardware and data, the records of one flight were decoded and digested in time to improve the next hop. Dividends in performance and reliability were obvious after six flights had been logged by Regulus II.

All six had been flown by one vehicle.

**Chance Vought uses comprehensive testing and data analysis to assist the engineer through unexplored problem areas. Test facilities strengthen every phase of the development cycle, and procedures are aimed at feeding data quickly into the engineering process.**

Scientists and engineers: pioneer with Vought in new missile, manned aircraft and electronics programs. For details on select openings, write to: C. A. Besio, Supervisor, Engineering Personnel, Dept. A-24.

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**RAYTHEON MANUFACTURING COMPANY, WALTHAM 54, MASS.**

direction from here (Fairbanks) to Big Delta and a little beyond, and it will be cloudy down around Seattle.

Recordings of radio contacts with Flight 100 as it progressed toward Seattle were studied. The flight canceled its IFR clearance at Haines, Alaska, and continued VFR. From this point to Annette, it reported being VFR. Company operating procedures for day VFR passenger operations provided that no aircraft be flown at an altitude less than 1,000 ft. above the surface or less than 1,000 ft. from any mountain, hill or other obstruction to flight. As a result of this accident the company procedures were revised to require that all flights, IFR or VFR, be conducted at or above the IFR minimum en route altitude. It was also made mandatory that altitude be reported on VFR flights.

At Annette, Alaska, a DVFR clearance was obtained for penetration of the CADIZ and the Western Security Identification Zone. According to company witnesses, a flight into a defense zone is required to report cruising altitudes as above mean sea level and that the reports from Flight 100 at 1,000 DVFR would indicate that, unless the flight was over water or very low terrain, it was violating the company minimum en route altitude rule.

A direct course from Annette to Pt. Hardy and thence via Amber 1 to Patricia Bay passes directly over terrain which rises to an elevation of several thousand feet. In point of fact, the minimum en route instrument altitude over portions of this route is as high as 8,000 ft.

A position report was transmitted from N 90449 in which the aircraft's position was declared as being 30 mi. west of Comox, B. C., at 1636 at 1,000 DVFR. Information received from the Department of National Defense, RCAF, detailed radar plots of the plane's position in the vicinity of Comox. At the same time, 1636, this radar system had plotted N 90449's position 10 mi. south of Comox at an altitude of 2,500 ft. msl.

The final transmission received from Flight 100 shortly before the crash was a normal routine position report stating that the flight had passed over the Dungeness fan marker at 1716 VFR. Company employes identified a recording of this transmission as being in the voice of Capt. Currie, which they recognized.

## Low Altitude Observed

Several ground witnesses in the vicinity of Dungeness observed the aircraft just prior to the crash. All these witnesses stated their attention was drawn to the airplane because of its unusually low altitude. One ground observer reported that the aircraft flew through several low clouds and disappeared into an overcast estimated to be about 1,000-1,500 ft. high and which obscured the tops of the surrounding hills. Several seconds later this witness heard and felt an explosion. He said because considerable blasting is done in that area he did not associate the noise with an aircraft accident until later when he heard a report of the accident.

All these witnesses described a low overcast lying to the south and southeast of Dungeness; also, that some scattered scud existed at about 1,000 ft. and thickened to form a low scud ceiling between Sequim and Blyn, Wash. Approximately one hour after the aircraft was reported as missing, a Coast Guard helicopter attempting to search along the proposed flight path reported that the cloud level dropped to the water along a line from Sequim Bay and Port Townsend across to Fort Casey on Whidbey Island.

Investigation disclosed that Alaska Airlines conducts a continuous training program to maintain pilot proficiency and to keep them current on all regulations and policies. Both pilots had been in the employ of Alaska Airlines for many years and according to their respective route checks were well qualified over the route involved. Also, both were proficient in the aircraft involved and had received training in the flight simulator. Prior to the subject flight they had received a rest period of 26 hr., 28 min.

## Investigation Analysis

Nothing was found in the course of the investigation to indicate any mechanical difficulties during this flight. All maintenance had been performed as required. Enough parts were recovered at the wreck to determine that the aircraft had been intact prior to the initial contact with the trees.

Damage to the propeller blade shim plates precluded precise determination of the blade angles which they indicated, and thus accounts for the variation recorded. These values and the blade angles indicated by the dome positions are quite conclusive that substantial power was being produced by all engines and that the airplane was being operated in the cruise configuration.

All the witnesses stated that the airplane appeared to be in normal flight and none noted anything unusual about the engine sound. In addition, the flight had been in regular radio contact with numerous ground stations over the entire route and had ample opportunity to report any malfunction or emergency encountered. Also, if any such difficulty had arisen, the crew was obligated to inform the company. No such report was received. Further, a normal routine position report was received by AIRINC (Aeronautical Radio, Inc.) only minutes before the crash. Had there been anything amiss with the flight it most certainly would have been reported at this time. From all of these reasons, the Board considers it reasonable to presume that no in-flight emergency existed and that the aircraft was operating normally until it struck the mountain.

There were several facts disclosed by the investigation which are significant and relate to the operational quality of the flight. First, Capt. Currie had not properly completed his flight log. Company regulations require that this form, which is the only in-flight record from the crew, be filled out completely while en route.

## Altitude Report Wrong

Secondly, along the route segment from Pt. Hardy to Patricia Bay, Capt. Currie reported his altitude as 1,000 ft. In order to have been at its reported altitude of 1,000 ft., the flight path of the aircraft would have had to follow a meandering course over water at times as much as 25 mi. north of Amber Airway 1. Radar determination and qualified eyewitnesses placed the aircraft approximately on the airway and at


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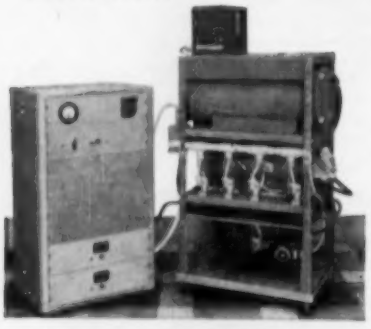

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an altitude of 2,500-3,000 ft. msl. It is, therefore, obvious that Capt. Currie was reporting his flight altitude in feet above the ground which was incorrect since he was obligated to report altitude as above msl. The captain had flown this route for a considerable length of time and knew, or should have known, the CADIZ regulations mean sea level.

Thirdly, in one of Capt. Currie's reports he gave his position as being 30 mi. west of Comox, B. C. At that instant, RCAF radar showed him to be 10 mi. south of Comox. We have been unable to rationalize this report with Capt. Currie's known position and the Board can, therefore, only believe that Capt. Currie was not aware of his precise position.

It also indicates to the Board that Capt. Currie did not properly utilize the facilities he had available to determine his position.

Fourthly, eyewitnesses in the Dungeness area saw the aircraft underneath an overcast and at an estimated altitude of 1,000-1,500 ft. These witnesses all described a distinct line of clouds below this overcast and lying directly across the flight path ahead of the aircraft. These clouds were described as obscuring the tops of foothills which rose to an altitude of about 2,100 ft ahead of the plane. Two of these witnesses stated the aircraft entered these clouds.[5] Civil Air Regulations require that a pilot, when about to enter instrument conditions, request an Air Traffic Control clearance prior to flight in controlled airspace.[4] He is required to maintain VFR until that request is approved and the appropriate ATC clearance is issued. Capt. Currie did not request an IFR clearance but continued directly into clouds.

It is the opinion of the Board that these incidents indicate that the conduct of the entire flight was haphazard and certainly not equal to that expected from an airline captain.

### Terrain Studied

In its efforts to determine the cause of this accident the Board studied the terrain in the area between Dungeness and Seattle. This route segment of Amber Airway 1 passes over the Miller peninsula which is located between two bays 3-4 mi. apart on the southern shore of the straits of Juan de Fuca. While these two bays do not appear to be similar when projected on a chart, it is believed possible that at low altitude and in a slightly hazy atmosphere a pilot, in a casual glance, seeing only one or a portion of one of these bays, could mistake it for the other.

It was found that if Flight 100 had been approximately three mi. east on a parallel course it would have passed over Port Discovery, the more eastern bay. It was also noted that the terrain over which the flight would have flown on the way to Seattle was much less than 1,000 ft. It was further noted that the terrain between Washington Harbor, the most western bay, and Seattle rose to an altitude of about 2,100 ft., a fact of which Capt. Currie was undoubtedly well aware.

It is therefore considered probable that Capt. Currie mistakenly identified Washington Harbor as Port Discovery and, thinking he was three mi. east of his actual position, entered the overcast at an altitude which he thought was sufficient to clear the ground. The Board is constrained to consider that the laxity and inattention exhibited by the crew throughout the flight, and the fact that the aircraft was flown into instrument conditions without an appropriate clearance, lend substantial credence to this presumption.

[5] CAR 41.114(b).
[4] CAR 60.10, 60.30(b), 60.31(c), 60.40, 60.42.

### CAB Findings

On the basis of all available evidence the Board finds that:

- **Aircraft and crew** were currently certificated for subject flight.
- **Aircraft had been maintained** in airworthy condition.
- **No malfunction** or emergency existed and aircraft was intact prior to its initial contact with mountain.
- **Several errors** and omissions in course of flight indicate crew was lax and not giving proper attention to duties.
- **Navigational error** resulted in aircraft being 3-4 mi. west of flight path assumed by crew.
- **Pilot flew** into instrument weather without obtaining proper clearance.
- **Aircraft crashed** in terrain obscured by clouds.

### Probable Cause

The Board determines that the probable cause of this accident was a navigational error and poor judgment exhibited by the pilot in entering an overcast in a mountainous area at a dangerously low altitude.

By the Civil Aeronautics Board:

James R. Durfee
Chan Gurney
Harmar D. Denny
G. Joseph Minetti
Louis J. Hector

## SUPPLEMENTAL DATA

### CAB Investigation

The Civil Aeronautics Board was notified that the aircraft was overdue shortly after its estimated time of arrival in Seattle. An investigation was initiated immediately after the wreckage was located in accordance with the provisions of Section 702(a)(2) of the Civil Aeronautics Act of 1938, as amended. Depositions, ordered by the Board, were taken at Seattle, Wash., on May 2 and 6, 1957, and at Sequim, Wash., on May 7, 1957.

### Air Carrier

Alaska Airlines, Inc., is incorporated under the laws of the Territory of Alaska and maintains its principal place of business at Anchorage, Alaska. The company possesses a current temporary certificate of public convenience and necessity issued by the CAB and an air carrier operating certificate issued by the Civil Aeronautics Administration which authorize the carriage of persons, property, and mail over the route described in this report.

### Flight Personnel

Capt. Lawrence F. Currie, age 41, was employed by Alaska Airlines Apr. 1, 1943. His flying hours totaled 12,033:11, of which 8,023:04 were in DC-4 equipment. Cap-

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tain Currie held a valid airman certificate with an airline transport rating and type ratings in C-46, DC-3 and DC-4 aircraft. His last six-month instrument check was passed Dec. 22, 1956, and his last route check was Aug. 8, 1956. He passed his last first-class physical Nov. 24, 1956.

Copilot Lyle O. Edwards, age 39, was employed by Alaska Airlines June 26, 1947. His flying hours totaled 10,791:51, of which 4,532:20 were in DC-4 equipment. Mr. Edwards held a valid airman certificate with an airline transport rating and type ratings in C-46, DC-3 and DC-4 aircraft. His last six-month instrument check was passed Oct. 4, 1956, and his last route check was Oct. 5, 1956. He passed his last first-class physical July 25, 1956.

Stewardess Elizabeth Goods was employed by Alaska Airlines Nov. 1, 1956. She completed her training period Nov. 30, 1956, and was assigned to flight duty.

Douglas C 54B-DC, N 90449, serial number 27239, was manufactured Dec. 12, 1944. Flying hours on the aircraft totaled 28,835:53. A continuous maintenance program was conducted by Alaska Airlines for the aircraft and all pilot reports and scheduled time inspections had been made and all discrepancies affecting its airworthiness had been corrected. The aircraft was equipped with Pratt & Whitney R-2000-7M2 engines and Hamilton Standard propellers, model 23E50-505, with model 6507A-O blades.

## Propeller Bearing Blamed in Accident

**Washington** — Civil Aeronautics Board last week handed down investigation reports on two accidents—one involving an American Airlines DC-7, the other a corporate aircraft. Three persons were killed in the latter crash.

The American Airlines DC-7 lost the nose section and propeller of its No. 1 powerplant near Memphis, Tenn., last March 5 while en route to San Francisco from New York. Flying parts struck and pierced the pressurized fuselage causing explosive decompression, the CAB said. Flying debris within the cabin and the abrupt pressure change resulted in several personal injuries. The aircraft, however, landed at Memphis Airport approximately seven minutes later without difficulty.

CAB said probable cause of the accident was failure of the propeller thrust bearing assembly which resulted in the propeller's separation.

The other accident involved a Lockheed Lodestar owned by the United States Steel Corp. and operated by Columbia-Geneva Steel Co., a subsidiary. The plane crashed about five miles north of Tyrone, Penn., last Dec. 20, killing the pilot, copilot and a company official. CAB determined that the probable cause of the accident was loss of control for reasons unknown resulting in a rapid decent during which structural failure occurred.

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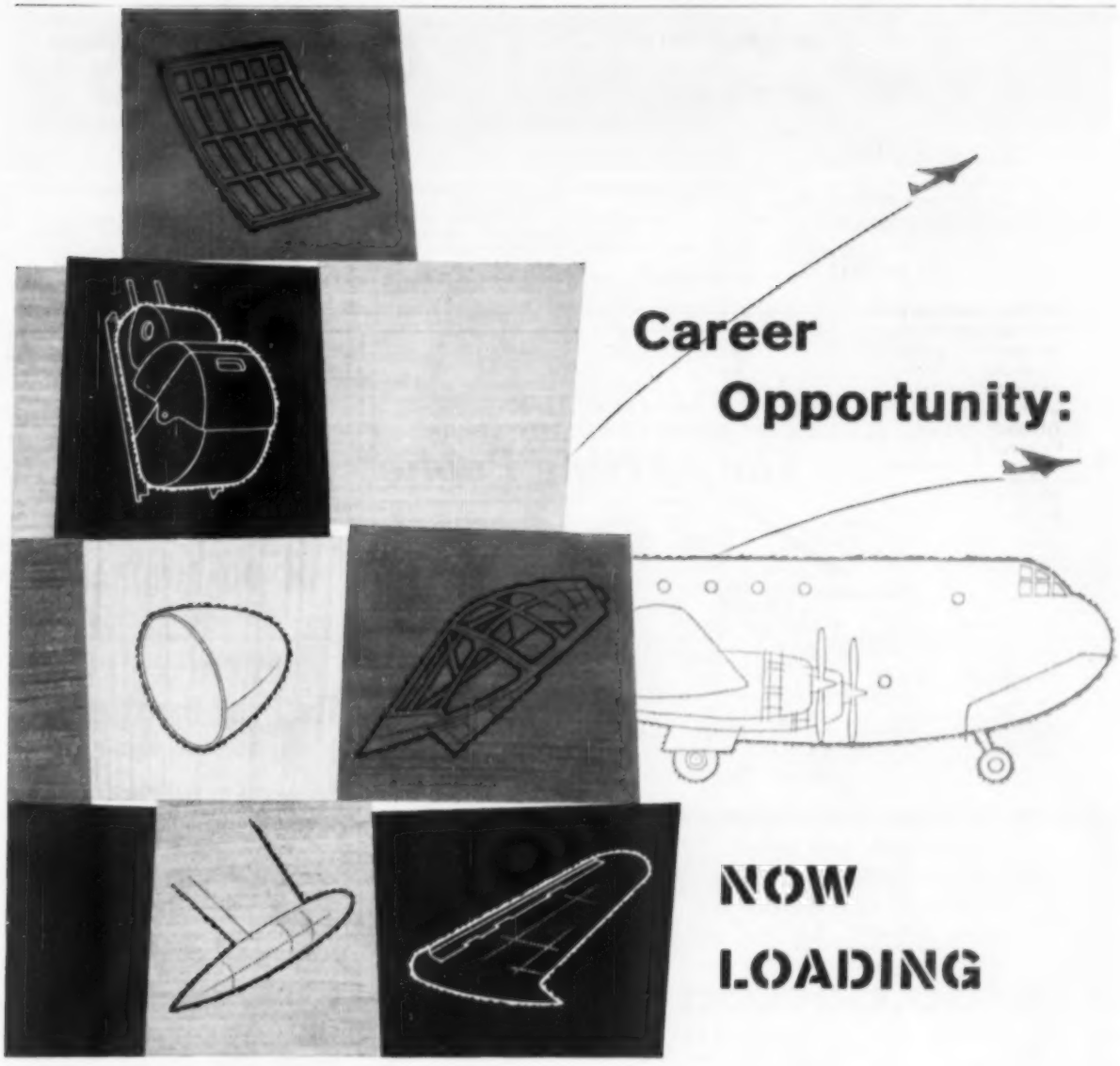


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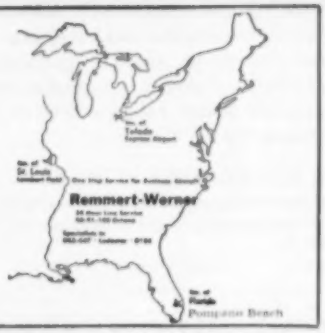


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*Left to right: S. S. Edwards, flight dynamics; B. W. Marsh, aerodynamics; M. Tucker, Aerothermodynamics Department manager; and R. L. Nelson, project aerodynamics, discuss reentry dynamics.*

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# LETTERS

## Fatigue Clarification

I have read with interest Mr. L. S. Jablecki's letter (AW Oct. 21, p. 150) inspired by Russell Hawkes' article (AW Sept. 23, p. 64) about my Institute of the Aeronautical Sciences presentation on fatigue last September. Although Mr. Jablecki is quite outspoken in his disapproval of what he has read and is strongly insistent on his disagreement with my suggestions, I do not feel that we are as far apart as the tone of his remarks would indicate.

The apparent difference between his position and mine is due, I think, to his interpretation of the headline and other phrases in the story. Although the article itself is excellent, the headline and other expressions unfortunately can be misinterpreted to mean that I (and presumably the Douglas Aircraft Co.) distrust and therefore do not use, laboratory fatigue test procedures. Nothing, of course, could be farther from the truth.

The problem, as Mr. Jablecki seems to recognize, is how to evaluate and use the characteristically erratic data that the fatigue phenomena generates, both in the laboratory and in service. One solution, of course, is to use an arbitrarily high order of conservatism; that is, design the part to last 5 or 10 times longer in a laboratory test than any theoretical analysis would demand. Another method which I discussed in my talk, is to run all laboratory tests against a set of standard or "control" specimens. The Douglas Aircraft Co. is fortunate in that it has such a wealth of service data and has so many high-time airplanes to observe, that the "control" specimens can be related to actual service performance directly rather by the use of theory.

Contrary to Mr. Jablecki's suspicions, evaluating fatigue test data by the use of standards results in rather more laboratory testing than other methods, because an entire laboratory fatigue history on the service airplane must be developed to establish the standards, as well as running a complete program for the new airplane. This procedure also turns out to be considerably more conservative than most "scatter factor" evaluation methods in use, and results in designs that are much more fatigue resistant in the laboratory than the 5 or 10 times mentioned above.

The fact remains, that designing for fatigue resistance requires a different approach than other types of design. This is rather aptly highlighted by Mr. Jablecki's mention of wind tunnel and track testing. Results of these and other tests are consistently reproducible within about 5% but it is a rare fatigue test indeed, that is consistently reproducible within about 500%. One of the best statements of the Douglas Co.'s philosophy toward evaluating fatigue data is found in the book "Fatigue of Metals and Structures" by Grover, Gordon and Jackson of Battelle Memorial Institute prepared for the Department of the Navy, dated 1954 (p. 35): "The first objective (estimation of fatigue lifetime) is the more difficult to attain; in fact, it is, in most cases not safe to depend directly on laboratory test results for quantitative design of structures to withstand a specified number of cycles of repeated loading."; (and p. 36): "A most important general principle in good design to avoid fatigue failure is continually to seek correlation of design calculations with observations from service experience. As such correlations are developed increasing confidence in the use of trends observed in laboratory tests can be developed."

Mr. Jablecki's comment on the definition of "fatigue life" illuminates the difficulty of determining an accurate, widely acceptable definition. He says ". . . it was well known among engineers that the term applied not to the aircraft, but to the 'weakest' component of the aircraft." All engineers do not accept this view. In fact, Mr. Jablecki is an engineer and he suggests that an airplane has ". . . approached its fatigue life by noticeable cracks in wing spar caps, fuselage longerons, etc." These, of course, are the "strongest" components of the aircraft.

So, as I said before, Mr. Jablecki and I are not too far apart. The sources of information he cites, I agree with; his confusion about definitions I also recognize, so in my discussion at the IAS I made a small attempt at clarification. It is, however, the nature of the fatigue phenomena to create more confusion, and certainly to create many differences of opinion.

EMERSON H. LABOMBARD
Douglas Aircraft Company, Inc.
Santa Monica, Calif.

***Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address Letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.***

## Questions Statement

Your editorial of Sept. 9 ("Missile Misinformation") was very interesting, especially the next to the last paragraph.

Your statement that movie films taken from the public beaches were shown two days later in 600 European movie houses is revealing. How is this accomplished? How are these films developed, copied, transported and disbursed to 600 overseas recipients in 48 hours?

A statement that is difficult for me to believe is that ". . . technical experts could reconstruct all significant detail of the missile structure. . . ." People with whom I am acquainted have been in the rocket and missile business for several years and have looked at many thousands of feet of film taken close up. It is claimed that it is difficult to determine from the films whether a particular missile stage is liquid or solid, to say nothing of fabrication details. Additionally, it is frequently not evident from the films—even color close-ups—what types of propellants are used by the rockets; often, hundreds of feet of telemetry records do not reveal the cause of failure, even to the telemetry experts.

Indeed, these "technical experts" of whom you speak must be highly competent individuals, worth their weight in missiles to any missile manufacturer. Their very presence at a flight test would preclude the necessity for much filming and telemetering since they could merely observe a flight and determine the causes of failures.

Yes, I, too, wonder who is "kidding" whom. Statements like these (concerning "technical experts") from the editor of a magazine make me question other of the magazine's contents.

A. N. BAXTER
Los Angeles, Calif.

*(First showings of Atlas newsreel films were in London two nights after actual firing at Cape Canaveral, Fla. Showing followed in the rest of the 600 odd European theaters subscribing to this newsreel syndicate during the next few weeks. Reader Baxter and USAF technical intelligence experts who analyzed Atlas newsreel films may differ over what is "significant" detail but this was substance of their report eventually sent to National Security Council.—Ed.)*

## Regulation Necessary

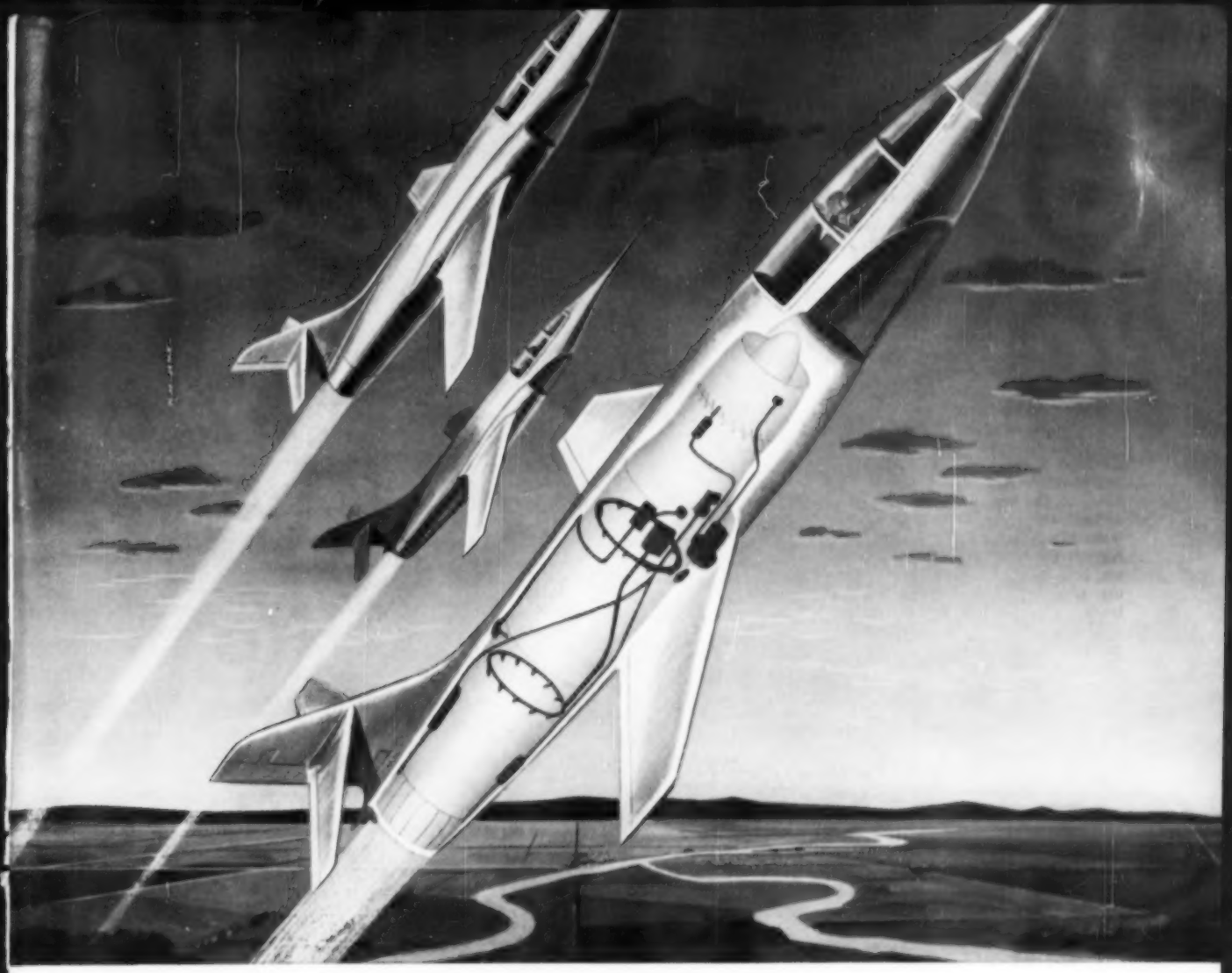
I do not agree with the contention of your economics professor that the aircraft industry does not need regulation (AW Nov. 4, p. 43). The industry certainly needs regulation of the physical movement of traffic and it also needs price regulation. The Civil Aeronautics Administration and the Civil Aeronautics Board must work together to help provide America with adequate airplane passenger and cargo service at reasonable fares and tariffs. We cannot depend on one airline to see that this is done; we cannot depend on several airlines to see that this is done; we must depend on the government.

As things stand now the airlines must ask the CAB to allow them to increase fares which they claim they need to make up for a reduction of income at a time of increased expenses. How do we know that an increase in fares of a certain percentage across the board will increase revenues and help the progress of the air transport movement? On the contrary, I think that air fares designed to suit the masses of consumers would do better for all. If fares are raised too much many people will not take airplane trips. Furthermore, not to take one trip at one time will mean that another trip will not be taken at another time. The load factor has been mentioned in the CAB reports and is a very important thing to consider.

The airlines are not making the best use of their resources.

We have been using regulation in our democracy for some time and, in many cases, I think that it has worked very well. You know we have agencies to regulate railroads and buses. I am sorry that we have not been able to regulate the airplane engine and airframe industries. With the cold war going on they have been able to make good profits.

CHARLES W. SHEPARD
Atlanta, Ga.



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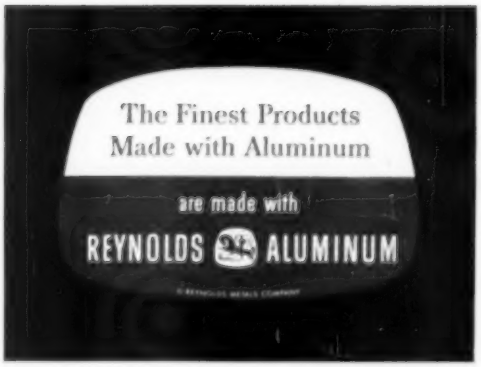


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